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THE CENTRAL EXPERIMENT STATION [1]

NORA J. CRUZ

In late 1951 official correspondence and publications of the UP College of Agriculture began leaving Los Baños with the heading "UP College of Agriculture and Central Experiment Station." Thus was announced without fanfare the crystallization of an idea which for nearly 40 years had roused far-sighted leaders of agriculture.

Experiment stations had from time to time been set up in key regions of the Philippines. The College of Agriculture itself had one, established by Legislative Act No. 2730 on February 15, 1918. What the country needed, the leaders felt, was a central experiment station in which agricultural research could be coordinated and rid of wasteful duplication and inefficiency.

That Los Baños should be the site of such a research center seemed logical to many. Its natural merit as an experiment station had weighted Dr. E. B. Copeland's decision in its favor when in 1907 he was assigned by the Bureau of Education to select a location for an agricultural school. But more telling than the nearness of Mt. Maquiling with its temperate winds and the diversity of soils was the tradition of scientific inquiry which marked the college from the start—a tradition which was sometimes discounted with regret by the economically pressured scientist or with impatience by the callow student, but which nevertheless persisted.

This was the research tradition which dug in and survived the lack of funds since the outlay of 1918. The sum of ₱125,000 bought more farm lands, work animals, and machinery. Beyond these barest of essentials the College staff had to rely on pertinacity and "make-do."

The same tradition weathered the second world war, gathered the pieces, and began again from there.

It was the tradition which prompted the Philippine-United States Agricultural Mission in 1947 to recommend for the College "...ample and continuing appropriations for research...[to] be pro-

[1] General Contribution No. 874.

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vided by legislative enabling acts, similar to the Hatch and Adams Acts of the U. S. Congress."

And it was this tradition which the Bell Mission of 1950 recognized as "one of the bright spots in Philippine agriculture and forestry" and which moved it to strongly urge the establishment of a central experiment station operated as a part of the College of Agriculture.

The placing of the central experiment station in Los Baños has not been without attendant problems. To the normal pains of revitalizing work has been added a complicating rise in enrollment. A balance has had to be struck; research must be strengthened, but not at the expense of the quality of instruction. Through the successive tenures of ECA, MSA, FOA, and now ICA, the staff has had to deal with one challenge after another in discharging its task of producing trained agriculturists and home technologists and running an effective agricultural experiment station.

Today out in the experiment station farm a new power plant rumbles at all hours. Three wells feed the water and irrigation systems. The land is drained by canals and underdrains and crossed by an extended dirt road. In the barns, shops, and laboratories, full-time researchers operate newly purchased equipment and machinery. An electron microscope is being put together within waving distance of the station analytical laboratory. Buildings are going up, books and supplies coming through, staff members being sent abroad. A complement of visiting American professors lends technical assistance. Promising young people are gaining skill in conducting specialized researches and in initiating new ones.

All these serve the cause of agricultural knowledge. Increasingly the advisory research committee of the Central Experiment Station is processing outlines of projects which require teaming up with other station divisions and with government bureaus and private concerns as well. The future looks well for the speedy solution of the farmer's applied problems and the continuity of basic investigation on which rests the science of agriculture.

THE OCCURRENCE OF ACETIC ACID IN SUGAR-CANE LEAVES [1]

APOLINARIO R. CARANGAL, JR., AND ERLINDA TUCAY

Acetic acid was found to the extent of 0.71 to 1.91 per cent of the dry weight of the leaves of College 39 sugar cane. Together with aconitic acid, it accounts for almost all the nonnitrogenous acids of sugar-cane leaves. Perhaps acetic acid or related compounds play an important role in biosynthesis in sugar cane.

Among the groups of compounds present in sugar-cane juice are the nonnitrogenous acids. The principal acid is aconitic acid, whose presence was detected as early as 1877 (Behr, 1877). The concentration of this acid in Louisiana juice solids varies from 0.3 to 1.6 per cent. It may represent as much as 90 per cent of the nonvolatile acids (Balch, Broeg, and Ambler, 1946). The occurrence in cane juice of such acids as malic, succinic, glycolic, formic, and oxalic acids has been determined only in qualitative tests and analytical methods in the past years. Recent application of ion-exchange resins and chromatographic methods has allowed the identification of fumaric, succinic, malic, glycolic, mesaconic, and oxalic acids in sugar cane (Marvel and Rands, 1950; Wiggins, 1952; Roberts, Fore, and Martin, 1953a & b). Since these acids are present in the cane juice it is probable that they are also present in the leaves, but in varying amounts.

In addition to some of the acids present in sugar-cane juice, lactic, formic, acetic, and propionic acids have been identified in blackstrap molasses. They arise from bacterial action. Juice expressed from damaged cane or soured juice has volatile acids, largely acetic acid (Fort and Lawitzen, 1938). Thus the presence of acetic acid has been ascribed to bacterial action and deterioration of the juice.

In this study the presence of acetic acid in the leaves was determined by using the column chromatographic procedure of Bulen, Varner, and Burrell (1952). Acetic acid and related compounds are used most extensively as building blocks in biosynthesis as shown by isotopic studies. Their presence in the leaves may serve as proof of the role of these acids in biosynthesis in the sugar cane.

[1] Central Experiment Station Contribution No. 1841.

EXPERIMENTAL PROCEDURE

Leaf samples. Leaves from mature and immature College 39 canes were used in this work. The leaves from one cane were separated into three groups based on maturity and immediately dried in the forced-draft oven (80°C.) for 24 hours. The dried samples were ground and stored in the desiccator for 3 to 14 days prior to the determination of the acids.

Preparation of organic-acid fractions. Weighed amounts of the samples were treated with 4N H_2SO_4, mixed with silica gel, and extracted with ether (previously washed with 0.1N $KMnO_4$ and distilled water) for 24 hours. The acids in the ether extract were recovered as their sodium salts by titration with NaOH, and the alkaline extract was evaporated to dryness.

Separation, identification, and determination of acetic acid. The acetic acid of the organic-acid fractions was separated from the other acids by elution on a silica gel column according to the method of Bulen *et al.* (1952). It was identified by its displacement volume and the usual qualitative tests. The amount of the separated acids was determined by titration with .01N NaOH and phenol red as indicator.

DISCUSSION OF RESULTS

Acetic acid was found to the extent of 0.71 to 1.91 per cent of the dry weight of the leaves (table 1). Perhaps it occurs as free acid and in salt form in the leaves and not as a result of other factors as deterioration or bacterial action. In these forms acetic acid plays an important role in the buffer system of the cell sap. The values obtained are lower since the acetic acid can readily volatilize under the condition of dryness of the sample. More accurate results would have been obtained if the samples had been lyophilized. Because of such experimental error no comparison could be made of the acetic acid content of young and old leaves from mature and immature canes.

Balch, Broeg, and Ambler (1945) found that the leaves contain three to five times as much aconitic acid as the millable canes. In some of the analyses of the same leaves performed in the Central Experiment Station laboratory a higher amount of acetic than aconitic acid was found, and smaller quantities of acids corresponding to the formic and lactic acid groups of the chromatographic

TABLE 1.—*Acetic acid content of the leaves of mature and immature sugar cane*

STAGE OF MATURITY OF THE CANES	SAMPLE	PERCENTAGE OF ACETIC ACID [a]		
		A [b]	B [b]	C [b]
Mature	I	1.16	1.64	1.64
	II	1.32	1.23	0.99
	III	1.24	0.79	1.14
	IV	0.95	1.09	0.71
Immature	V	1.04	1.43	1.06
	VI	1.18	1.38	1.42
	VII	1.58	1.91	1.41
	VIII	1.02	1.05	0.96

[a] Based on the dry weight of the samples.
[b] These letters refer to the grouping of the leaves based on maturity, A being the oldest and C the youngest leaves.

procedure of Bulen *et al.* (1952). Acetic acid presumably is an important biological intermediate like aconitic acid because of its presence in high amounts. It may also be present in the cane juice not as a breakdown product of deterioration or bacterial action but as a biological intermediate. Isotopic studies will help much to establish the role of acetic acid or related compounds in the biosynthesis of carbohydrates in sugar cane.

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Scientific discourse provides man with a map such that he can determine his expectations with increasing accuracy on the basis of what he encounters in direct experience. Science as an institution involves all the procedures by which such discourse is obtained; science as a habit of mind involves a preference for the scientific form of discourse and the procedures utilized in the control of such discourse. Science as a whole ministers to man's need to be able to determine correctly his expectations, and hence his activity, in terms of the evidence which lies at hand. It is in the realization of this purpose that scientific discourse has been evolved and is being progressively controlled.—*Charles W. Morris.*

RELATIONSHIP BETWEEN YIELDING ABILITY OF SINGLE CROSSES AND DEGREE OF GENETIC DIVERSITY OF THE INBRED LINES [1]

ONOFRE Q. BALLESTEROS [2]

In general, single crosses between inbred lines of considerable genetic diversity gave significantly higher yields than those from single crosses of the same parentage or of closer origin. There was a significant negative correlation between days to silking and yielding ability which seemed to be a direct result of the more severe stalk breakage in the later maturing single crosses. The stalk breakage was due to the strong typhoons that occurred when the corn was well-eared. A positive relation existed between yielding ability and length of ears.

The superiority of hybrids over their parents is called hybrid vigor or heterosis. This superiority is thought to be caused by the interaction of favorable dominant or partially dominant growth factors contributed by the two parents. It is possible that the superiority may also be due in part to overdominance or the allelic interaction of genes at the same locus. The amount of hybrid vigor expressed usually depends on the degree of relationship of the two parents.

This study was planned to compare the performances of single crosses of corn in which the parent inbred lines represented various degrees of genetic diversity. The work was done at the Central Experiment Station of the UP College of Agriculture and in the Plant Breeding laboratory from May, 1953, to February, 1954.

In studies on crosses between inbred lines, Wu noted that on the average, single crosses between lines in which both inbreds came from the same variety yielded significantly less than the single crosses in which the inbred lines came from two different local varieties, and much less than the single crosses whose inbreds came from two varieties of different ecological origin.[3] Hayes and Johnson likewise

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[1] Central Experiment Station Contribution No. 1842. Thesis presented for graduation with the degree of Bachelor of Science in Agriculture, April, 1954. Prepared in the Department of Agronomy under the direction of Drs. D. L. Umali and H. K. Hayes.

[2] The author is very thankful for the suggestions and criticisms of Dr. A. M. Brunson, Cornell Visiting Professor of Plant Breeding.

[3] Shao-Kuei Wu, *Jour. Amer. Soc. Agron.* 31, 131 (1939).

obtained results showing a direct relation between the origin of the inbred lines and their combining ability in single crosses.[4]

Eckhardt and Bryan[5] compared the yielding abilities of a considerable group of double crosses of (A × B) (X × Y) with (A × X) (B × Y) or (A × Y) (B × X) and reported that, in general, the (A × B) (X × Y) double crosses had a higher yielding ability than the other types of combinations. A and B were used to designate the inbred parents produced by one variety, and X and Y, those from another variety.

Johnson and Hayes[6] classified inbreds on the basis of their combining ability in top crosses into two broad groups called H, or high combiners, and L, or low combiners. In comparing series of crosses of H × H, H × L, and L × L, they noted that although H × H, on the average, greatly exceeded L × L in yielding ability, H × L yielded about as well as H × H.

MATERIALS AND METHODS

The single crosses used in this study were furnished by the Division of Plant Breeding, Department of Agronomy. The introduced inbred lines were obtained by Dr. H. K. Hayes from Dr. F. D. Richey, Coordinator of the Southern Corn Breeding Regional Program of the United States, and from the Rockefeller Foundation in Mexico and in Colombia, South America. The origin of these crosses or varieties is summarized in table 1.

College White Flint inbred lines were previously tested by Santos in top crosses with Bicol White Flint and were found to excel in general combining ability.[7] The inbred lines of Bicol White Flint were likewise selected because of their good general combining ability in top crosses with College White Flint.

College Yellow Flint was used as one of the checks because seed of College White Flint was not available when this study was conducted.

The design used in this experiment was a randomized block design in which each block included 22 single crosses with two standard varieties as checks. These were grown in four replications. Single rows, one meter apart, of 17 hills, one-half meter apart, were prepared. Guard rows were planted around every block.

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[4] H. K. Hayes and I. J. Johnson, *Jour. Amer. Soc. Agron.*, 31, 710 (1939).
[5] R. G. Eckhardt and A. A. Bryan, *Jour. Amer. Soc. Agron.*, 32, 347 (1939).
[6] I. J. Johnson and H. K. Hayes, *Jour. Amer. Soc. Agron.*, 32, 479 (1940).
[7] I. S. Santos, *Philippine Agriculturist*, 31, 290 (1952).

TABLE 1.—*The inbred parental lines used in the production of the different single crosses*

GROUP	SINGLE CROSS OR VARIETY	ORIGIN
I	1 4 × CW 165	Tennessee White Dent × College White Flint
	I 1 × CW 165	" " " × " " "
	I 4 × A 209	" " " × Bicol White Flint
	I 1 × A 207	" " " × " " "
	I 100 × A 207	Colombia White Flint × Bicol White Flint
	I 100 × A 209	" " " × " " "
	I 86 × A 209	" " " × " " "
	I 86 × CW 163	Colombia White Flint × College White Flint
	I 87 × CW 163	" " " × " " "
	I 70 × CW 165	Mexico White Dent × College White Flint
II	A 204 × A 207	College White Flint × Bicol White Flint
	A 205 × A 207	" " " × " " "
III	A 209 × A 210	Bicol White Flint × Bicol White Flint
	A 209 × A 211	" " " × " " "
	A 210 × A 211	" " " × " " "
	A 210 × A 213	" " " × " " "
	A 210 × A 214	" " " × " " "
	A 211 × A 214	" " " × " " "
	A 200 × A 201–2	College White Flint × College White Flint
	A 200 × A 204	" " " × " " "
	A 201 × A 203	" " " × " " "
	A 203 × A 204	" " " × " " "
IV	BWF	Bicol White Flint (open-pollinated)
	CYF	College Yellow Flint (open-pollinated)

Only the ears from hills with two plants and surrounded by four adjoining hills with either one or two plants were harvested for yield. After their fresh weights were taken, the husked ears were placed in the drier at a temperature of about 40°C. until they were dry enough to be shelled.

RESULTS AND DISCUSSION

Yield. The average yields per hectare of the different single crosses calculated at 16 per cent moisture and on the basis of a perfect stand ranged from 39.7 to 85.8 cavans, with an over-all average of 66.56 cavans (table 2). Differences were highly significant.

The calculated LSD at the 5 per cent level was 12.8, and at the 1 per cent level 16.9 cavans. When subtracted from 85.8 cavans per hectare, the highest mean yield (I 4 × CW 165) obtained, these values gave 73.0 and 68.9 cavans, respectively, which were greater

TABLE 2.—*Yield per hectare of the different single crosses and checks*

GROUP	SINGLE CROSS OR VARIETY	AVERAGE YIELD IN CAVANS	YIELD IN PER CENT OF THE AVERAGE CHECK VARIETIES
	I 4 × CW 165	85.8	117.7
	I 1 × CW 165	85.7	117.6
	I 4 × A 209	79.2	108.6
	I 1 × A 207	66.7	91.6
	I 100 × A 207	69.0	94.6
I	I 100 × A 209	65.2	89.5
	I 86 × A 209	56.7	77.8
	I 86 × CW 163	55.6	76.3
	I 87 × CW 163	62.7	86.0
	I 70 × CW 165	71.5	98.1
	A 204 × A 207	69.8	95.7
II	A 205 × A 207	75.2	103.2
		65.7	90.2
		70.4	96.7
	A 209 × A 207	57.1	78.4
	A 209 × A 211	63.7	87.3
	A 210 × A 211	52.4	71.9
	A 210 × A 213	66.6	91.4
III	A 210 × A 214	62.2	85.3
	A 211 × A 214	63.9	87.7
	A 200 × A 201–2	39.7	54.5
	A 200 × A 204	66.0	90.5
	A 201 × A 203	71.2	97.6
	A 203 × A 204	70.0	96.0
		61.3	84.1
IV	BWF	76.9	
	CYF	68.8	
		72.8	

Analysis of variance

SOURCE	DF	MS	CF
Varieties	23	421.99	5.14 [a]
Replications	3	8.89	
Error	69	82.02	

[a] Significant at P = .01 level.

than the average yield of College Yellow Flint but less than that of Bicol White Flint. One replication of Bicol White Flint gave a calculated hectare yield of 112.1 cavans, the highest yield obtained in the experiment and which may have been due to some uncontrolled errors.

Group I represents the greatest genetic diversity of parents as it is composed of all single crosses between a local line and a line introduced from the United States, Colombia, or Mexico. Group II represents intermediate genetic diversity of parents as the crosses are of lines from varieties which are both of local origin. The parents of each cross in Group III come from the same local variety and therefore represent the least genetic diversity.

The individual entries within each group were made in class centers of 7 cavans (table 3). The calculated standard error of the mean for a single group was ± 4.52 cavans.

TABLE 3.—*Frequency distribution of the average yields in cavans per hectare of the different groups* [a]

GROUP	YIELD CLASS CENTER							AVERAGE YIELD IN CAVANS PER HECTARE
	42	49	56	63	70	77	84	
I			2	2	3	1	2	69.3 ± 0.02
II				1		1		70.0 ± 0.08
III	1	1	1	5	2			60.2 ± 0.02
IV					1	1		73.5 ± 0.08

[a] Cf. table 1.

Groups I and II had about the same average yield and were both superior to group III (table 4).

TABLE 4.—*Mean percentage differences and standard errors of the differences of the four classes* [a]

GROUP	CLASS		
	II	III	IV
I	1.0 ± 5.26	11.60 ± 3.04	4.30 ± 5.26
II		12.60 ± 3.20	3.30 ± 6.79
III			15.90 ± 5.26

[a] Cf. table 3.

The difference between group I (greatest genetic diversity) and group III (least genetic diversity) was 11.60 ± 3.04 in favor of group I and is highly significant. Similarly, the difference between group II (intermediate genetic diversity) and group III is 12.60 ± 5.26 in favor of group II and is also highly significant. This indicates that higher yielding corn hybrids can be expected when the parental inbreds come from unrelated sources than when they originate from the same variety. It is of interest to note that the aver-

age yield of group III, where the two parental inbreds come from the same variety, is significantly less than the yield of the open-pollinated varieties used as checks. This may be due in part to the unusually high yield of some of the check plots as noted earlier.

Agronomic characters. The averages of the different classes on plant height, days from planting to silking, percentage of root and stalk lodging, number of good ears to a plant, ear length, number of kernel rows, and shelling percentage are presented in table 5.

TABLE 5.—*Average of the averages of the different classes of single crosses and checks*

AGRONOMIC CHARACTER	GROUP			
	I	II	III	IV
Plant height, centimeters	293.3	281.0	282.6	291.5
Lodging:				
Root, per cent	16.1	17.0	27.9	15.0
Stalk, per cent	48.3	37.5	41.7	53.0
Kernel rows to an ear	14.9	13.2	14.7	13.9
Number of good ears to a plant	0.91	0.97	0.91	0.98
Ear length, centimeters	15.6	15.1	14.8	13.8
Days from planting to silking	52.8	49.5	52.0	50.5
Shelling percentage	76.7	80.5	79.6	81.5
Number of two-stalk hills	13.7	13.9	13.5	12.4

Three rather strong typhoons which caused severe lodging and stalk breakage occurred after the corn was already well-eared. The late-maturing crosses were more severely injured, and this damage was the probable cause of the lower yields of a number of the diverse crosses.

The data on stalk breakage and root lodging were taken on the two-stalk hills harvested and are presented on a percentage basis. The percentage of root lodging of the single crosses in group I was only 16.1 per cent as compared with 27.9 per cent in group III. The checks also excelled in standing ability, indicating that further selection in the native white varieties should lead to further improvement in the standing ability of their inbred crosses. The percentage of broken stalks in group I was 48.3, which was slightly higher than that in group II, 37.5. The greater percentage of broken stalks in group I may have been due to the severe injury of several late crosses within this group. Several early crosses excelled in having only a small percentage of broken stalks.

Relation of yielding ability to some agronomic characters. The data on number of days to silking, number of good ears to a plant, and ear length were correlated with the yielding ability of the single crosses. The coefficient of correlation of days to silking and yielding ability was −0.608, which is significant at the 1 per cent point. On the average, the later maturing crosses yielded less than the earlier maturing crosses. This relationship appears to be a result of the damage caused to the plants by the severe typhoons, as it seems probable that under more normal conditions the later maturing crosses would have given the higher yields.

There was a positive correlation of 0.480 between number of good ears to a plant and the yielding potential of the different single crosses, and of 0.475 between yielding ability and length of ears. These figures are significant at the 5 per cent point. The length of ears and the number of good ears to a plant apparently influence directly the yield. These inherited characters should be considered by corn breeders.

Field observations of disease and insect injuries. The most prevalent disease observed was downy mildew of corn, caused by *Sclerospora philippinensis* Weston. Infection was so light, however, that no appreciable injury to yield resulted.

The injuries caused by insects were largely due to the larvae of the corn earworm, *Heliothis armigera* Hübner.[8] Although the damage was rather severe, it did not appear to influence yield of the single crosses.

[8] Identified by Dr. S. M. Cendaña of the Department of Entomology.

FOLIAR FERTILIZATION OF RICE PLANTS WITH NITROGEN [1]

R. K. De la Fuente and J. R. Velasco

During the vegetative stage of the rice plants, urea fertilizer as a spray on the leaves was less effective than as a soil top-dressing. Urea top-dressing in turn was less effective than a top-dressing of ammonium sulfate.

During the booting stage, urea spray on the leaves was just as effective as a top-dressing of ammonium sulfate, if not more effective.

Supplying plants with essential elements through the leaves, although not a new idea, has not found wide application. This is probably due to the fact that the method has not been made to work successfully in several trials. Because of the many advantages that are credited to the method, further study to make it more applicable should be done. Some of the advantages which are frequently mentioned are quick and efficient absorption, elimination of losses due to leaching and to fixation (which often occurs in soil fertilization), and more accurate control of plant food intake regardless of the physical condition of the soil.

MATERIALS AND METHODS

Two growing media were used: culture solutions in the first three experiments, for better control of the nitrogen status in the medium, and soil cultures in the fourth and fifth experiments. The latter were for determining the applicability of foliar fertilization under simulated lowland field conditions.

Thailand rice, an early-maturing lowland variety, was used in all of the experiments.

All the chemicals used in the study, with the exception of the fertilizer grade ammonium sulfate, were high-grade salts.

EXPERIMENTS AND RESULTS

Experiments in culture solutions

Experiments 1 and 2. The object of these experiments was to find the nitrogenous compounds that can supply nitrogen to rice

[1] Central Experiment Station Contribution No. 1843. This includes data from the thesis presented by the senior author in partial fulfillment of requirements for the B.S.A. degree from the College of Agriculture, April, 1955.

plants through the leaves. Rice seedlings were grown in Espino's 4-salt solution (Espino, 1920) for three weeks. Then the plants were transferred to a modified solution from which nitrogen had been eliminated. In the first experiment (December 18, 1953, to February 14, 1954) solutions of ammonium sulfate (1.32 per cent), sodium nitrate (1.7 per cent), and urea (0.6 per cent) were sprayed on the leaves of plants deprived of nitrogen for one week. The solutions were computed to have the same concentration of nitrogen. The plants were sprayed daily until 200 ml. of each solution was used up.

The number of functional leaves [2] tillering and the general appearance of the plants were noted at weekly intervals. Twenty-four hours after the last spraying, the plants were harvested, the tops separated from the roots, and their fresh and dry weights determined.

It was observed that the general yellowing of all the leaves as a result of the withholding of nitrogen from the medium for one week was remedied to a very slight degree by the spraying of the nitrogenous solutions. Only the young leaves turned green; the mature leaves remained chlorotic and later dried up. The ammonium sulfate and sodium nitrate solutions did not kill the plants but injured the leaves so severely that the drying of the mature leaves was hastened. The average number of functional leaves at the time of harvesting of the plants was 3.2 for the urea-sprayed plants, 2.8 for the deficient plants, 2.8 for the plants sprayed with sodium nitrate, and 2.0 for those sprayed with ammonium sulfate.

With the data from the nitrogen-deficient solution as the basis of comparison, it will be noted that the complete culture solution gave 2.30 times as much dry weight of tops and 1.80 times dry weight of roots (table 1). Urea spray gave 1.84 times as much tops and 1.75 times as much roots. The tendency in both cases was for more growth in tops than in roots. The roots of plants in the complete culture solution were almost equal in size to those of the urea-sprayed plants.

On the other hand, spraying with $NaNO_3$ gave 1.43 times as much tops and 1.50 times as much roots, and with $(NH_4)_2SO_4$, 1.25 times as much tops and 1.30 times as much roots. The tendency was for more growth in roots than in tops.

[2] A leaf was counted as functional when one-half or more of the total area of the leaf was still green.

TABLE 1.—*Effect of nitrogenous fertilizer sprays on average weight in grams of tops and roots* [a]

TREATMENT	FRESH WEIGHT		DRY WEIGHT		DRY TO FRESH WEIGHT RATIO	
	Tops	Roots	Tops	Roots	Tops	Roots
$(NH_4)_2SO_4$ spray	1.60	0.65	0.61	0.26	2.62	2.50
$NaNO_3$ spray	2.17	1.30	0.70	0.30	3.10	2.50
$CO(NH_2)_2$ spray	2.42	1.67	0.90	0.35	2.70	4.80
Complete solution	4.22	1.77	1.13	0.36	3.74	4.90
N-deficient solution	1.35	0.60	0.49	0.20	2.76	3.00
SMD at 5%	0.24	0.24	0.15	0.04		

[a] Average of 4 replications.

It seems that of the three sprays, only urea approximately maintained the normal proportion in the plant although each of the sprays seemed to have been utilized by the plant in various degrees.

In ratio of dry weight to fresh weight of a plant part as a measure of succulence, the nitrogen-deficient plants had 1:2.76 for tops and 1:3.00 for roots. Plants in the complete culture solution had 1:3.74 for tops and 1:4.90 for roots. The normal plants were much more succulent than the nitrogen-deficient plants. Urea-sprayed plants did not have more succulent tops than the nitrogen-deficient plants, but their roots were almost as succulent as those of the plants in the complete culture solution. Sodium nitrate sprays tended to produce less succulent plants than the complete culture solution, but decidedly more succulent plants than the deficient solution. Spraying with ammonium sulfate produced more dried-up tops and roots than the nitrogen-deficient solution.

The second experiment using essentially the same procedures was conducted from April 2, 1953, to June 1, 1954. Urea, which was found most promising in the last experiment, was compared with the following organic compounds: glycine, triethanolamine, hydroxylamine hydrochloride, sulfanilamide, and diphenylamine. As in the first experiment, a culture maintained in complete solution and one where nitrogen was withheld from the roots and the leaves were included. Each treatment had only three replications.

Three consecutive daily sprayings of triethanolamine and hydroxylamine hydrochloride killed the young rice plants. These compounds acted in the same way as some herbicides. Since it was not

the object of the study to look for herbicides, no further observations were made on this matter.

The diphenylamine- and sulfanilamide-sprayed plants looked very much like the nitrogen-deficient plants, except for the darker green young leaves of the sprayed cultures. At the concentration used, these two compounds did not injure the plants.

The plants sprayed with urea were better in appearance than the glycine-sprayed plants, which were in turn superior in general appearance as well as in dry weight to any of the other culture plants.

At harvest, the plants in the complete solution (lot IV) had 2.2 times as much tops as the nitrogen-deficient plants (lot I); the urea-sprayed plants (lot II), 1.6 times; and the glycine-sprayed plants (lot III), 1.3 times (table 2). The roots of plants in lots II and IV were almost equal in weight, again suggesting that urea somewhat promotes less growth of tops than the complete solution but has no adverse effect on the growth of roots. Under normal conditions the tops were more than three times as much as the roots. With nitrogen deficiency, the ratio went down to 2.6. In other words, the adverse effect was more on the tops than on the roots. The nitrogen sprays, except urea, allowed more growth of tops, resulting in a top-to-root ratio of about 2.9:1.

TABLE 2.—*Effect of nitrogenous organic compound sprays on average dry weight of young rice plants* [a]

CULTURE NUMBER	TREATMENT	DRY WEIGHT IN GRAMS		TOP-ROOT RATIO
		Tops	Roots	
I	N-deficient	0.353	0.136	2.59
II	Urea	0.576	0.230	2.50
III	Glycine	0.473	0.160	2.95
IV	Complete	0.786	0.236	3.33
V	Diphenylamine	0.406	0.140	2.90
VI	Sulphanilamide	0.383	0.133	2.88
VII	Triethanalamine	Plants died	—	
VIII	Hydroxylamine hydrochloride	Plants died	—	
	SMD at 5%	0.21	0.03	

[a] Average of 3 replications.

With the dry weights of the plants as an indirect gauge of nitrogen utilization, it can be seen that nitrogen in several compounds sprayed on the leaves was assimilated (tables 1 and 2). It must be remembered that the amounts of nitrogen sprayed on the

leaves of the plants were the same. As was expected, the plants differed in their response to the different compounds, probably because of the differences in the physical and chemical properties of the compounds. For example, triethanolamine solution had a small contact angle with the leaves. This quality is a criterion of good wettability.

Experiment 3. The objects of this experiment were to determine the range of urea concentration tolerated by rice plants and to find the optimum concentration for growth. One culture pan was used in growing the nitrogen-deficient culture, and another for the culture in complete solution. Five culture pans were divided into two lots each—one lot without the wetting agent and another with the wetting agent Triton B-1956 [3] at a concentration of 2.5 per cent. The urea concentrations tested were 0, 0.25, 0.50, 0.75, and 1.00 per cent. Spray drift was prevented from coming in contact with the other lots by enclosing the plants being sprayed with two pieces of cardboard much higher than the tallest plants.

Unlike in the first two experiments, the plants in this trial were sprayed as soon as the nitrogen had been removed from the medium.

The amount of urea in each culture was computed on the basis of 33 kilograms of nitrogen to a hectare. Since different concentrations were used with the same amount of urea, the amount of solution varied.

With the ranges of concentration used in this experiment, no relation was observed between the extent of injury to the leaves and the concentration of the urea solution. The plants were injured to a very slight degree, at most, three to five necrotic spots 1 centimeter or less in diameter in all of the urea-sprayed cultures. Because the wetting agent at the concentration used injured the rice plants beyond recovery, only the dry weights of the plants not sprayed with the wetting agent are shown in table 3. The differences in dry weight of stems and leaves among the plants sprayed with the different concentrations were not significant. Compared with the control, only the .50 per cent concentration was significant at the 1 per cent level. This concentration is therefore the optimum for young rice plants. The differences in dry weight of the roots of the treated plants were not significant.

The tolerance of plants to sprays of urea varies with the species. Montelaro *et al.* (1952) found that tomatoes were injured by 0.6

[3] Triton B-1956 is a trade name used by Rohm and Haas Co., Philadelphia, Pennsylvania.

TABLE 3.—*Effect of different concentrations of urea spray on dry weight of tops and roots* [a]

TREATMENT	DRY WEIGHT IN GRAMS	
	Tops	Roots
0.25% urea	1.33	0.45
0.50	1.92	0.65
0.75	1.42	0.45
1.00	1.45	0.65
Complete	2.69	0.85
N-deficient	0.84	0.37
SMD at 5%	0.77	Insignificant

[a] Average of 4 replications.

per cent urea solution. Apple leaves have been observed to be injured by a concentration of 0.95 per cent (Hamilton *et al.*, 1943). Chesnin and Shafer (1953) found that at the rate of 60 pounds nitrogen to the acre or about 60 kilograms to the hectare, a concentration of 43 per cent of urea did not harm wheat plants at the blooming stage.

Hinsvark *et al.* (1953) found that the differences in tolerance of plants to sprays of urea depended on the urease activity on the leaves. Plants with very high urease activity were easily injured, whereas plants with low urease activity could tolerate higher concentrations of urea. Hinsvark and his coworkers attributed this foliage injury to the accumulation of ammonia brought about by rapid hydrolysis of urea in plants with high urease activity. Plants easily injured by urea sprays responded to physiologically tolerable amounts of urea.

Emmert and Klinker (1950) observed that equal molecular concentrations of sucrose used in solution with urea reduced the injury caused by urea on tomato leaves. Hinsvark *et al.* (1953) found urease activity to be partially inhibited when sucrose was added to the spray solution, the partial inhibition being caused by the smaller amount of urea entering the leaf. Montelaro *et al.* (1952) reported that magnesium sulfate reduced the injury caused by urea on tomato leaves.

The plants sprayed with urea in this experiment responded better than those in the two experiments previously discussed. It was only in the production of tillers that the urea-sprayed plants did not equal the performance of the plants in the complete culture solution. The urea-sprayed plants were even taller than the plants grown in the complete culture solution, and also slightly darker in color.

Two conditions could have made this possible:

(1) During the spraying, it was almost always cloudy and cool. This might have brought about a reduction in the formation of injurious biuret, which, according to Haas and Bruscha (1954), might be formed from urea at high temperature.

(2) The plants in this experiment were sprayed with urea solution as soon as the nitrogen in the culture solution was removed. Cook and Boynton (1952) observed greater urea absorption in leaves with high original level of nitrogen.

Experiments in soil cultures

Experiment 1.—Effect of soil and foliar applications of nitrogen during the vegetative period. This experiment was conducted from June 9 to October 20, 1954. Subsoil of Lipa clay loam taken from a bulldozed area in Faculty Hill was prepared and measured out into pots 24 centimeters in bottom diameter, 29 centimeters in top diameter, and 29 centimeters high. There were six pots in each culture treatment (table 4). In any culture, the prescribed amount of fertilizer was divided into two equal portions. The first was applied at 10 days, and the second at 45. The original intention was to make a third application at booting, but this plan was abandoned because the flowers came much earlier than expected.

The urea solution for spraying on the leaves was at 0.6 per cent concentration. Palmolive soap at 1 per cent was used as a wetting agent.

Observations. About 20 days after the first application of the fertilizer, there were apparent differences among the cultures. Culture IVB, with the high rate of ammonium sulfate as top dressing, was dark green and seemed the healthiest. Culture IVA, with the low rate of ammonium sulfate, matched culture IIB in general appearance. This implies that as a nitrogen source ammonium sulfate was twice as good as urea. Cultures V and VI were of the same appearance as culture IVA, suggesting that the nitrogen spray in these cultures had no apparent beneficial effect.

Great variability was observed in date of flowering even among replications. In general, unfertilized plants flowered later than fertilized ones.

Effect on yield. The data in table 4 show that urea spray seemed to have had some beneficial effect on grain yield (culture IA vs. culture VII). However, urea applied to the soil was more beneficial

TABLE 4.—*Effect of different treatments on average weight in grams of grains to a plant*

CULTURE NUMBER	TREATMENT	GRAINS
IA	31.1 kg. N, urea, leaves	7.4 [a]
IB	62.2 kg. N, " "	10.4
IIA	31.1 kg. N, urea, soil	11.7
IIB	62.2 kg. N, " "	15.9
IIIA	31.1 kg. N, urea, soil and leaves [b]	10.0
IIIB	62.2 kg. N, " " " [b]	16.4
IVA	31.1 kg. N, ammonium sulfate, soil	13.0
IVB	62.2 kg. N, " " "	22.0
V	31.1 kg. N, urea, leaves	
	+ 31.1 kg. N, ammonium sulfate, soil	14.2
VI	31.1 kg. N, glycine, leaves	
	+ 31.1 kg. N, ammonium sulfate, soil	13.5
VII	No treatment	5.2
	SMD at 5% = 2.0	

[a] Average of 6 replications.
[b] One half of the amount was applied to the soil as top dressing; the other half was sprayed on the leaves.

(culture IIA vs. culture IA). A combination of soil application and leaf spray was better than leaf spray alone, but seemed to be equaled by soil application alone.

Soil application of ammonium sulfate at the higher rate was better than soil application of urea (culture IVB vs. culture IIB). The addition of urea on glycine spray to the top dressing of ammonium sulfate tended to increase the yield, but not to the extent of being significant in agricultural practice.

Because the flowers came while the second dose of nitrogen was being sprayed, the difference in yield among the lots could not be ascribed to the effect of nitrogen on the vegetative or on the reproductive stage.

It was demonstrated by Velasco and others (1953, 1954) that nitrogen was needed by rice plants at three stages of development. The striking observation was that fertilizer applied just before booting had a marked beneficial effect. Nitrogen is probably not much needed at this stage, its conceivable role being just to increase chlorophyll for more efficient manufacture of starch for the grain. Urea spray applied at this stage might be sufficient to provide the nitrogen needed by the plant. It was with the idea of looking into this angle that the second soil culture experiment was conducted.

Experiment 2.—Effect of soil and foliar applications of nitrogen at booting. This experiment was conducted from November 16, 1954, to April 15, 1955, on soil used in the first experiment. The prospect of the nitrogenous fertilizer in the previous experiment having a residual effect made planning a bit uneasy. To dispel doubt and to have a basis for making allowances in evaluating results of this experiment, a second control was maintained. Culture IVB, which received the high rate of ammonium sulfate in the first experiment, was not fertilized and was designated as culture II in the second experiment. Any difference between it and culture I (no fertilizer in both experiments) could then be attributed to the residual effect of the previous treatment.

The amounts of fertilizers were computed on the basis of 100 kilograms N per hectare. The lots were laid out according to the scheme in table 5. The first application was at 30 days of age, the second at 58 days, and the third at 70 days.

TABLE 5.—*Effect of different treatments on average total weight in grams of grains to a plant*

CULTURE NUMBER	TREATMENT			WEIGHT OF GRAINS
	First and second applications		Third application	
I	0	0	0 N	4.5 [a]
II	0	0	0 N	5.2
III	50	25 [b]	25 kg. N, urea, soil	11.7
IV	50	25	25 kg. N, urea, leaves	11.8
V	35	35	30 kg. N, urea, leaves	15.1
VI	45	45	10 kg. N, urea, leaves	16.8
VII	50	25 [c]	25 kg. N, urea, leaves	21.0
VIII	50	25	25 kg. N, ammonium sulfate, soil	20.8
IX	50	25	25 kg. N, glycine, leaves	16.3
X	45	45	10 kg. N, urea, leaves	20.5
XI	0	90	10 kg. N, urea, leaves, ammonium sulfate	
			SMD at 5%	2.91

[a] Average of 6 replications.
[b] In cultures III to VI the first two doses of nitrogen were as urea applied to the soil.
[c] In cultures VII to XI the first two doses of nitrogen were as ammonium sulfate applied to the soil.

The urea and glycine solutions were at a concentration of 1 per cent. To increase the adherence of the spray solution on the leaves, Triton B-1956 was used as a wetting agent at a concentration of 0.1 per cent.

Observations. There was very little difference between the treatments during the two weeks following the first fertilizer application. Beginning the third week, the plants fertilized with urea (cultures III to VI) started to turn yellow and the old leaves dried up faster than normal. They were not any better than the unfertilized cultures except that they had slightly more tillers. The plants receiving ammonium sulfate (cultures VII to X) started to lose their dark-green appearance on the fourth week after the first treatment.

The lots differed conspicuously about the time of the second fertilizer application. The second dose of urea on cultures III to VI did not improve the generally unthrifty plants, which were yellow and not much taller than the unfertilized plants (74.1 cm. vs. 68.7 cm.) and had dried-up older leaves. In contrast, the plants with ammonium sulfate were big and tall (88.6 cm.) and had dark-green young leaves.

The third dose of nitrogen gave essentially the same effect as the second dose. Urea nitrogen, whether sprayed on the leaves or applied as top dressing, did not promote formation of more chlorophyll; on the contrary, the leaves developed tip burns which may be ascribed to injury from biuret. According to Haas and Bruscha (1954) this compound forms from urea at high temperature.

A surprising development occurred a few days before the flowers emerged. The plants receiving urea suddenly turned dark green and grew tall. At flowering, unfertilized plants were, on the average, 82.5 centimeters tall; those receiving urea, 104.2 centimeters; and those receiving ammonium sulfate, 109.8 centimeters. However, the urea-fertilized plants, although tall, had few tillers and were not much bigger than the unfertilized plants.

Effect on yield. Although culture II yielded more grains than culture I, the difference was not significant (table 5). It is therefore safe to assume that the fertilizer treatments in the previous cropping season had no appreciable residual effect. Culture III differed from culture IV in that its last dose of urea nitrogen was applied to the soil instead of to the leaves. Since they had practically the same yield, it can be concluded that leaf spray of nitrogen during the booting stage was just as good as soil application. Cultures IV, V, and VI differed from each other only in the proportion of nitrogen in the different doses. Heavy amounts of nitrogen during the first two applications (cultures V and VI) gave significantly higher yields than a heavy application at 30 days followed by two light doses (culture IV). Culture VII, like culture VIII, received ammonium

nitrogen in the first two applications, but, unlike culture VIII, it received a leaf spray of urea at booting instead of a third top dressing of ammonium sulfate. Again it can be seen that leaf spray at booting was just as good as top dressing. This was further substantiated by the yield of culture X. Although ammonium sulfate was generally more effective than urea, urea spray at booting seemed to equal, if not better, soil application of ammonium sulfate.

Culture XI was an incidental experiment on the effect on yield of light intensity during grain development. After the fertilizer treatments, three pots were kept in direct sunlight, and three in diffuse light. The plants in direct sunlight matured normally and produced well-filled grains. Those in diffuse light were very irregular in coming to head and in ripening. In addition, most of the grains were only half-filled. Varying light conditions may be one principal cause of failure of plants to respond to fertilizer application in the field. This aspect deserves further study.

DISCUSSION

All the data attest to the capacity of rice plants to absorb nitrogenous compounds sprayed on their leaves, but a method has yet to be devised to enable the plants to effectively use the nitrogen they absorb in this manner. The experimenter has to work within a very narrow effective range of urea concentration beyond which leaf scorching occurs. This is because urea hydrolyzes into ammonia which, although utilizable as a source of nitrogen, is extremely poisonous to the protoplasm.

Urea should be rendered innocuous by combination with certain compounds in the protoplasm. Obviously, the capacity of plants to resist urea injury depends, among others, upon their production of these neutralizing compounds. Because ammonia is a base, one is inclined to look for an acid as a neutralizing agent; organic acids suggest themselves. It would be a worthwhile contribution to our knowledge of nitrogen nutrition with the use of urea if we could find how organic acids fluctuate with changes in climatic conditions and how they bear on the utilization of urea by the plants.

The application of urea to promote vegetative growth has so far been unsatisfactory. But there seems to be a very fine prospect of using urea spray at the booting stage to supply the nitrogen required for good grain production. How much nitrogen to apply and how it can best be done is the subject of a later study.

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If...industrial society transforms the universities into places of research for industrial purposes, not only do the universities lose their function of asking radically for the truth, but the technical development itself will be stopped in the long run.—*Paul J. Tillich.*

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THE RATE OF GROWTH, MORTALITY, AND MATURITY OF S.C. WHITE LEGHORN CHICKS FED RATIONS WITH OR WITHOUT AUROFAC SUPPLEMENT [1]

QUIRINO M. SUGON

One-half per cent Aurofac markedly improved the feeding value of the College all-mash brooding and rearing rations. The improvement more than offset the added cost of the Aurofac in the rations.

At 24 weeks of age, lot I pullets weighed an average of 1176.5 grams and lot II pullets, 1362.0 grams.

The approximate amount of feed needed to raise one pullet in lot I from one day to 24 weeks was 10.9 kilograms, costing ₱2.72, and in lot II, 9.4 kilograms, costing ₱2.54.

In the first 12 weeks, lot I had an average mortality of 18.3 per cent and lot II, 7.7 per cent. In the second 12 weeks, the mortality of the pullets was 20.6 per cent in lot I and 11.0 per cent in lot II.

Investigations conducted in the UP College of Agriculture on the effect of adding Aurofac [2] to poultry rations have shown great promise. In their studies on New Hampshire chicks, Catalan [3] and Alcasid III [4] separately reported the superiority of the Aurofac-supplemented ration to the basal ration. Likewise, Salinas [5] found that New Hampshire pullets fed Aurofac were consistently heavier and had lower mortality than those given the unsupplemented ration.

As it would be of interest to find out the effect of Aurofac fed to S. C. White Leghorn chicks from the time they are one day old till they are 24 weeks old, this study was conducted from July, 1953, to June, 1954.

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[1] Central Experiment Station Contribution No. 1844. Thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture, October, 1954. Prepared in the Department of Animal Husbandry under the direction of Instructor Amado C. Campos.

[2] Aurofac is a trade name for a vitamin B_{12} and antibiotic feed supplement manufactured by the Lederle Laboratories Division of American Cyanamid Company. It is guaranteed to contain not less than 1.8 grams of aureomycin and 1.8 milligrams of vitamin B_{12} to a pound. In addition, it contains not less than 10 per cent crude protein, 1 per cent crude fat, and not more than 7 per cent crude fiber.

[3] M. V. Catalan, *Philippine Agriculturist*, **36**, 295 (1952).

[4] Eliseo N. Alcasid III, *Philippine Agriculturist*, **38**, 530 (1955).

[5] Francisco C. Salinas, *Philippine Agriculturist*, **38**, 465 (1954).

MATERIALS AND METHODS

Six hundred S. C. White Leghorn chicks from the College flock were divided into two lots for each of three trials. The first trial was conducted from July 23, 1953, to January 7, 1954; the second, from December 1, 1953, to May 18, 1954; and the third, from January 8 to June 25, 1954. In all the trials, 100 chicks were assigned at random to each of the two lots.

The chicks were wingbanded and weighed soon after removal from the incubator. The weekly weights from the second to the 11th week of each trial were taken on the lot basis. The initial weight for the first 12-week period and the biweekly weights from the 12th to the 24th week were taken individually. The chicks in both lots were brooded in electrically heated battery brooders during their first four weeks of life and were later transferred to unheated four-tiered wire cages where they remained until the end of the first 12-week period. After the first 12 weeks, the males were separated and only the females were retained for further study. These pullets were reared in roomy, single-tiered rearing houses with wire floors until they showed signs of approaching sexual maturity. Then they were transferred to individual battery laying cages.

Lot I, designated as the control lot, was given the College all-mash brooding ration for chicks during the first 12 weeks and the rearing ration for pullets during the second 12 weeks. These rations consist of the following ingredients, all parts by weight:

	REARING RATION	BROODING RATION
Rice bran	55	40
Ground corn	20	20
Fish meal	20	20
Copra meal	5	20
Salt	1	1

For every 100 kilograms of feed, 1 pint of cod liver oil was added to the brooding ration and 1.5 pints to the rearing ration whenever the birds could not get direct sunlight. Ten kilograms of ground shells and grit were also added to the rearing ration whenever the pullets were about to lay.

The same rations and supplements, with the further addition of ½ kilogram of Aurofac to every 100 kilograms of the mash, were given to the birds in lot II, the experimental lot. Aurofac was first thoroughly mixed with a little of the mash. More and more of the mash was gradually added until the desired quantity had been total-

ly mixed. The process was done by hand and then with a spade to insure complete and thorough mixing.

The rations were given dry. Fresh drinking water and ground shells and grit were left accessible to the birds at all times. Both lots received identical care and management.

RESULTS AND DISCUSSION

Rate of growth. The average of the three trials showed that the birds in lot II grew consistently faster than the birds in lot I (figs. 1 and 2). At the end of the first 12-week period, birds in lot II registered an average weight of 900.3 grams in trial 1, 885.5 grams in trial 2, and 742.0 grams in trial 3 as against 830.9, 750.1, and 640.5 grams in the corresponding trials of lot I (table 1). The 12th-week weights of male and female chicks in both lots were highly significant in favor of lot II. The weight advantage of lot II pullets was increased to 1476.7 grams in trial 1, 1421.5 grams in trial 2, and 1187.8 grams in trial 3 as against 1281.9, 1157.8, and 1089.7 grams in the corresponding trials of lot I. This difference in weight compared with the weight advantage of the pullets during the first 12 weeks would also be highly significant. With the 12th- and 24th-week weights of the birds as the second basis for growth comparison and assuming that the growth rate of lot I birds was 100 per cent efficient, the relative efficiency of lot II birds was about 113.6 per cent for both sexes at 12 weeks of age and 115.7 per cent for the pullets at 24 weeks of age.

The uniform results in all the trials favoring lot II birds once more indicate the superiority of Aurofac-supplemented College all-mash rations to the unsupplemented rations in promoting the growth of chicks. These findings corroborate those reported by Catalan,[6] Alcasid III,[7] and Salinas.[8]

Mortality. In all the trials, lot I had a comparatively higher death rate than lot II (table 1). Except in the second trial, for both lots the average death rate of chicks during the first 12 weeks was lower than that of pullets in the second 12 weeks. The average mortality among chicks was 18.3 per cent in lot I and 7.7 per cent in lot II. The biggest mortality was mostly due to coccidiosis during the early part of the study and to roup during the later part.

The higher percentage of mortality among the pullets in trials 1 and 3 of both lots may be attributed to the transfer of the birds

[6] Catalan, *op. cit.*
[7] Alcasid III, *op. cit.*
[8] Salinas, *op. cit.*

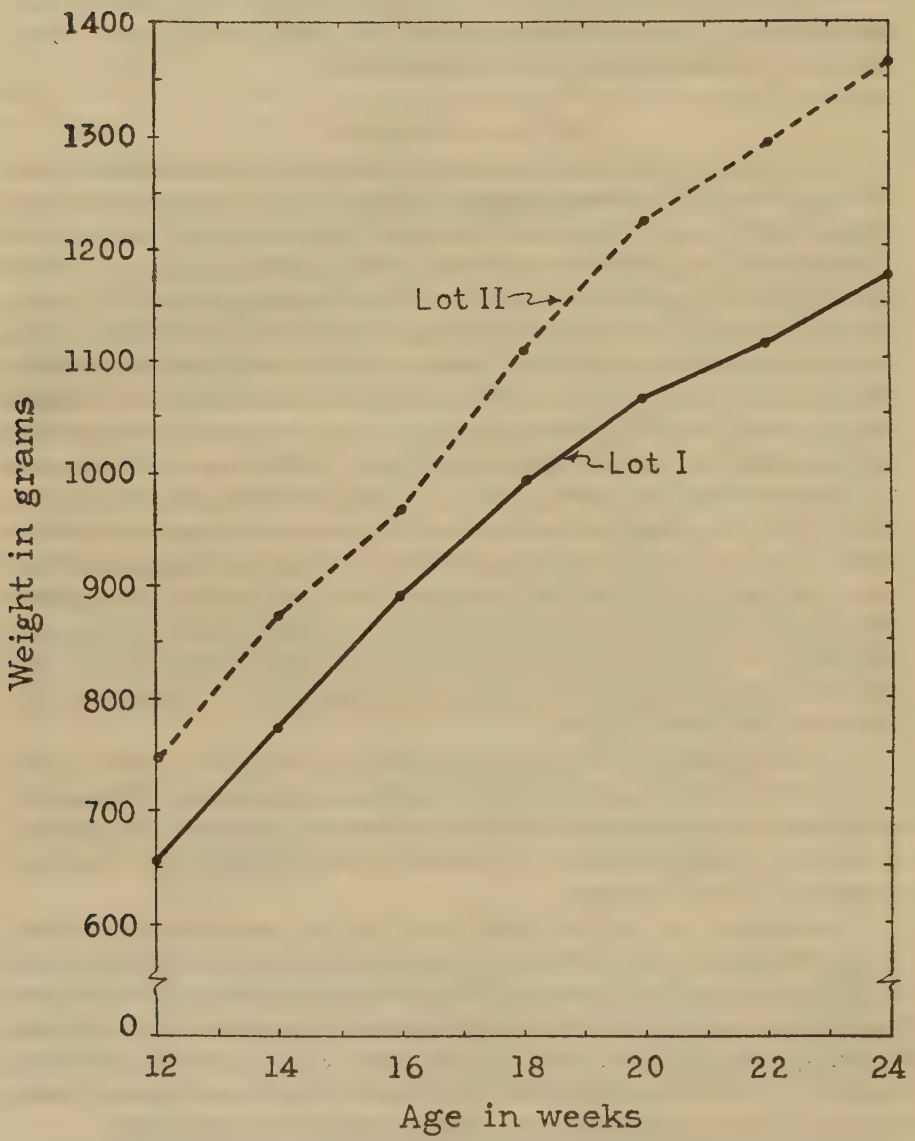

Fig. 1.—Average weekly rate of growth of Single Comb White Leghorn chicks in the three trials during the first 12 weeks of the feeding period.

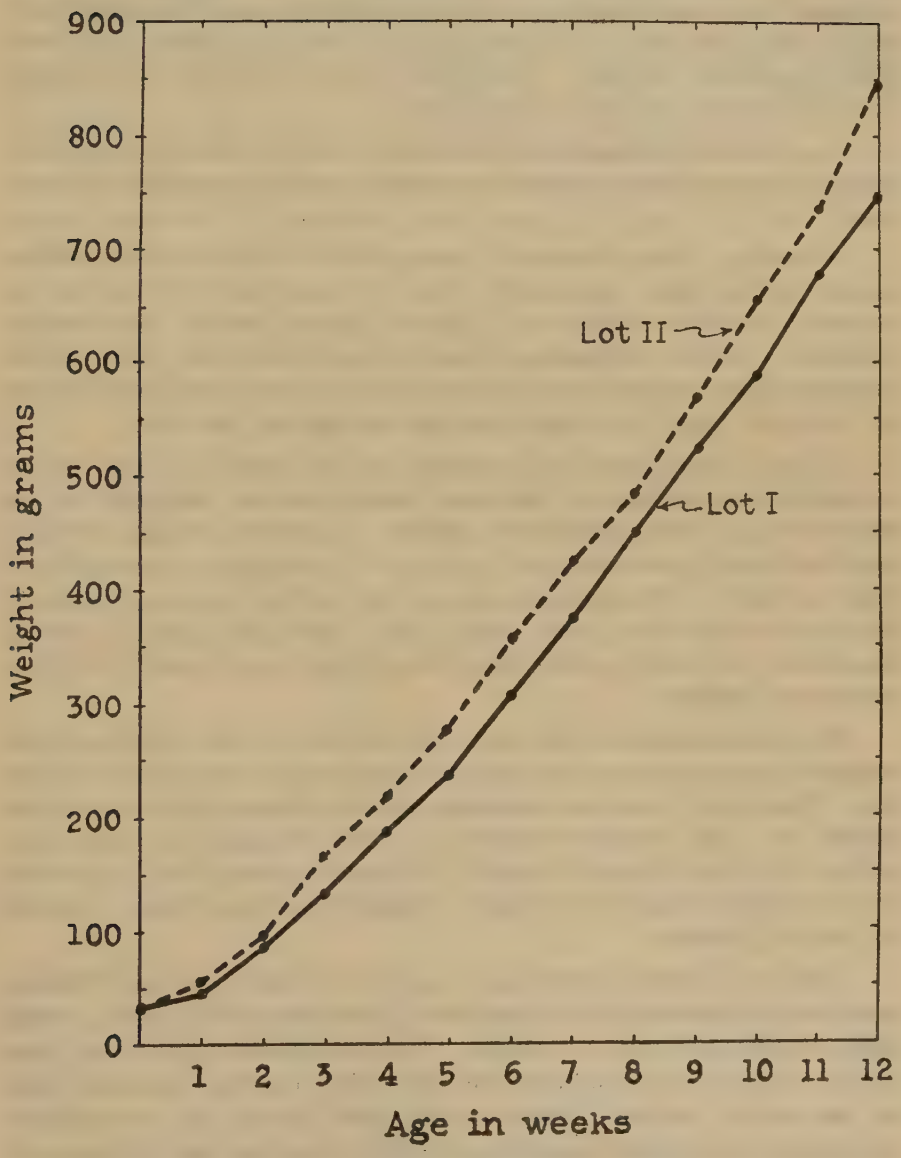

Fig. 2.—Average biweekly rate of growth of Single Comb White Leghorn pullets in the three trials during the second 12 weeks of the feeding period.

after the end of the first 12 weeks from the four-tiered wire cage inside the poultry building to the single-tiered rearing houses outside and then to the indoor battery laying cages. The changes to which the birds were subjected reduced their resistance and made them susceptible to roup. Apparently, Aurofac in the ration could not fully protect the birds from roup.

In general, the results of this study tend to confirm the reports made by past workers about the mortality-inhibiting effect of Aurofac.

Maturity. Sexual maturity among birds is indicated by the laying of the first egg. Sandoval [9] cited Jull as setting 150 days as the standard period in which S. C. White Leghorn pullets reach sexual maturity. In the Philippines, Castillo [10] reported that S. C. White Leghorn pullets raised from chicks imported from the United States in 1946 laid their first eggs after an average of 168 days.

In the present study, the average date of maturity could not be computed because not all the birds reached sexual maturity at the end of the 24-week observation period. It will be noted, however, that the highest percentage of laying and the earliest maturing birds were in lot II. The average ages of the earliest maturing birds in the three trials were 145.0 days in lot I and 136.7 days in lot II. These are very much earlier than the average ages reported by Sandoval and Castillo.

Feed consumption and cost. At the end of the 12th and 24th weeks, there were more birds in the experimental than in the control lot. Thus more feed was consumed by the former than the latter (table 2). The average amounts of feed consumed by each bird in lot I, however, were 0.3 and 1.2 kilograms more during the first and second 12 weeks of the study, respectively, than those consumed by the lot II birds.

The ratio of the 12th-week weights of the males and females was used in calculating the amount of feed consumed by the female birds during the first 12 weeks. This calculated figure was then added to the feed consumption of the pullets during the second half of the feeding period. Based on the total figure, the approximate amount of feed needed to raise one pullet from one day of age to 24 weeks was 1.5 kilograms more in lot I than in lot II. In terms of costs, lot I required one centavo more during the first 12 weeks, 17

[9] M. A. Sandoval, *Philippine Agriculturist*, 34, 26 (1950).
[10] Leopoldo S. Castillo, *Philippine Agriculturist*, 37, 124 (1948).

centavos more during the second 12 weeks, and 18 centavos more to grow one pullet to 24 weeks of age than lot II.

These results show that the improved feeding value of the College all-mash rations more than offset the added cost of the Aurofac.

Other observations. The Aurofac-fed birds were more vigorous, healthy, and uniform in size, feathered earlier, had glossier and smoother plumage, and exhibited deeper pigmentation than the birds fed the basal rations alone. In addition, the comb and wattles of the Aurofac birds were better developed, which possibly indicates earlier sexual maturity. There were more grade "A" pullets in the experimental lot.

TABLE 1.—*Average weight and mortality of birds of the two lots in the three trials*

ITEM	LOT I				LOT II			
	Trial			Average	Trial			Average
	1	2	3		1	2	3	
Number of chicks at start	100	100	100	100	100	100	100	100
Average initial weight of chicks in grams, both sexes	33.9	37.4	34.0	35.1	33.8	37.5	32.9	34.7
Average 12th-week weight of chicks in grams, both sexes	830.9	750.1	640.5	740.5	900.3	885.5	742.0	842.6
Average 12th-week weight of cockerels, grams	897.7	772.1	763.2	811.0	968.9	957.3	905.6	943.9
Average 12th-week weight of pullets, grams	764.1	728.1	517.9	670.0	831.8	813.7	578.5	741.3
Average 24th-week weight of pullets, grams	1281.9	1157.8	1089.7	1176.5	1476.7	1421.5	1187.8	1362.0
Percentage mortality of chicks from one day to 24 weeks of age	13.0	20.0	22.0	18.3	3.0	9.0	11.0	7.7
Number of pullets at 12th week	39	42	44	41	49	48	48	48
Percentage mortality of pullets from 12th to 24th week	20.5	11.9	29.5	20.6	12.2	6.2	14.6	11.0
Number of pullets at 24th week	31	37	31	33	43	45	41	43

TABLE 2.—*Amount and cost of feed consumed by chicks from one day of age to 24 weeks*

ITEM	LOT I				LOT II			
	Trial			Average	Trial			Average
	1	2	3		1	2	3	
One day to 12 weeks: [a]								
Amount of feed consumed, kg.	287.3	287.9	234.8	270.0	301.9	290.2	248.2	280.1
Average amount of feed consumed by each chick, kg.	3.3	3.6	3.0	3.3	3.1	3.2	2.8	3.0
Cost of feed consumed by each chick, pesos [b]	0.82	0.90	0.75	0.82	0.84	0.86	0.76	0.81
Twelve to 24 weeks: [c]								
Amount of feed consumed, kg.	238.2	302.6	241.4	260.7	292.6	313.9	256.3	287.6
Average amount of feed consumed by each pullet, kg.	7.7	8.2	7.8	7.9	6.8	7.0	6.2	6.7
Cost of feed consumed by each pullet, pesos	1.92	2.05	1.95	1.97	1.84	1.89	1.67	1.80
One day to 24 weeks: [d]								
Approximate amount of feed needed to raise one pullet to 24 weeks, kg.	10.7	11.7	10.3	10.9	9.8	10.0	8.4	9.4
Approximate cost of feed needed to raise one pullet to 24 weeks, pesos	2.67	2.92	2.57	2.72	2.65	2.70	2.27	2.54

[a] The figures are for both sexes.
[b] Cost of a kilogram feed: lot I, ₱0.25; lot II, ₱0.27.
[c] The figures are for pullets alone.
[d] The feed consumption figures used for the first 12 weeks of the feeding period have been adjusted based on the mean 12th-week weight of the pullets and cockerels.

PULSE RATE, FREQUENCY OF RESPIRATION, AND BODY TEMPERATURE OF PHILIPPINE GOATS [1]

JOSEPH C. MADAMBA

The mean pulse rate of the nine Philippine does was 91.51 beats per minute. The correlation coefficient between pulse rate and rainfall was −0.327; that between pulse rate and humidity, −0.371. Only the pulse rate was affected by season.

The average respiratory rate was 21.31 times per minute. A significant correlation coefficient of 0.495 was found between respiratory rate and atmospheric temperature.

The mean body temperature of the animals was 38.96°C. (102.13°F.).

The pulse rate, frequency of respiration, and body temperature of Philippine goats are valuable clinical aids in determining the state of their health. To obtain data on these three physiological characters and to find out if they are influenced by season, this study was conducted in the Department of Animal Husbandry from July, 1953, to June, 1954.

MATERIALS AND METHODS

Nine mature, apparently healthy female Philippine goats (No. 102, 105, 118, 120, 131, 137, 139, 158, and 169) belonging to the Department of Animal Husbandry were studied. The animals ranged in age from one year and two months to three years and eight months at the start of the experiment. They all received the same feeding, care, and management.

On the second and fourth weeks of each month between eight and twelve o'clock in the morning the pulse rate, frequency of respiration, and body temperature of the animals were determined. The pulse beats and frequency of respiration were counted for ten seconds at three different times, and the average of the three counts was multiplied by six to get the rate per minute.

The pulse rate was taken on the inner surface of the thigh where the femoral artery is. The frequency of respiration was determined by putting the palm over the nose of the animal and counting the

[1] Central Experiment Station Contribution No. 1845. Thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture, October, 1954. Prepared in the Department of Animal Husbandry under the direction of Dr. Gonzalo V. Garcia.

number of inhalations and exhalations. For the body temperature, a veterinary clinical thermometer was inserted full length into the rectum of the animal for at least three minutes.

Based on data on rainfall, relative humidity, and atmospheric temperature in this region recorded by the Weather Observation Division of the Department of Agricultural Engineering, January to May was considered the dry season, and June to December, the wet season.

RESULTS AND DISCUSSION

Pulse rate. The mean pulse rate of the nine Philippine does was 91.51 beats per minute. Malkmus found the pulse rate of goats in temperate countries to range from 70 to 90 beats per minute.[2] As shown in table 1 highly significant differences were found in the pulse rates of the different does (SMD at 5 per cent level = 3.71) as well as in those taken during the different months (SMD at 5 per cent level = 5.26).

TABLE 1.—*Analysis of variance of biweekly pulse rates of 9 Philippine does*

S.V.	D.F.	S.S.	M.S.	COMPUTED F-VALUE
Month (M)	11	2,520.60	229.15	5.41[a]
Animal (A)	8	922.93	115.37	2.72 [b]
M × A	88	3,728.40	42.37	1.90
Sampling error	108	2,410.00	22.31	
Totals	215	9,581.93		

[a] Significant.
[b] Highly significant.

Month	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Mean	96.67	91.33	91.71	90.33	96.00	96.67	89.78	88.44	93.89	85.89	88.78	88.67
Animal No.	102	105	118	120	131	137	139	158	169			
Mean	87.17	90.33	92.00	91.92	92.67	94.00	94.00	94.25	69.67			

SMD at	5%	1%
Month (M)	5.26	6.97
Animal (A)	3.71	4.92

Pulse rate and atmospheric temperature had an insignificant correlation coefficient (r) of 0.248 since r for 22 degrees of freedom at the 5 per cent level of probability was 0.404. Pulse rate and humidity had a correlation coefficient of −0.371; pulse rate and rainfall, a correlation coefficient of −0.327.

[2] B. Malkmus, "Clinical Diagnostics of the Internal Diseases of Domestic Animals," Alex Eger, Inc., Chicago, 1944, revised, 311 pp.

Respiratory rate. The average respiratory rate of the nine Philippine does was 21.31 times per minute. For temperate regions, a rate of 12 to 20 times per minute was reported by Dukes [3] and Malkmus.[4] Table 2 shows significant variations in the respiratory rates of native does (SMD at 5 per cent level = 2.03) and in those taken in the different months (SMD at 5 per cent level = 2.78).

TABLE 2.—*Analysis of variance of biweekly respiratory rates of 9 Philippine does*

S.V.	D.F.	S.S.	M.S.	COMPUTED F-VALUE
Month (M)	11	2,945.70	267.79	21.65 [a]
Animal (A)	8	240.59	30.07	2.43 [b]
M × A	88	1,088.30	12.37	1.15
Sampling error	108	1,160.00	10.74	
Total	215	5,434.59		

[a] Significant.
[b] Highly significant.

Month	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Mean	19.44	19.67	18.00	28.89	21.56	22.22	29.33	20.78	20.00	18.22	18.89	18.78
Animal No.	102	105	118	120	131	137	139	158	169			
Mean	20.25	20.67	22.25	20.75	21.92	21.33	23.33	21.67	19.67			

SMD at	5%	1%
Month (M)	2.78	3.68
Animal (A)	2.03	2.68

The respiratory rate of the does and the atmospheric temperature had a significant correlation coefficient of 0.495, showing that respiration rate increased with atmospheric temperature. The negative correlations between respiratory rate and humidity and rainfall were insignificant.

Body temperature. A mean body temperature of 38.96°C. (102.13°F.) was found among the nine does. This mean is slightly lower than the 39.27°C. (102.68 ∓ 0.062°F.) found by Damant, as cited by Dukes,[5] and the average of 39.0 to 40.5°C. (102.2 to 104.9°F.) found by Malkmus.

Table 3 shows that there were highly significant differences in body temperature among the nine does (SMD at 5 per cent level = 0.15) as well as in the different months (SMD at 5 per cent level = 0.21).

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[3] H. H. Dukes, "The Physiology of Domestic Animals," Comstock Publishing Co., Inc., Ithaca, New York, 1947, 795 pp.
[4] Malkmus, *op. cit.*
[5] Dukes, *op. cit.*

TABLE 3.—*Analysis of variance of biweekly body temperatures of 9 Philippine does in °C.*

S.V.	D.F.	S.S.	M.S.	COMPUTED F-VALUE
Month (M)	11	22.50	2.05	29.71 [a]
Animal (A)	8	4.57	0.57	8.26 [a]
M × A	88	6.09	0.07	1.17
Sampling error	108	6.46	0.06	
Total	215	39.62		

[a] Highly significant.

Month	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Mean	39.09	39.04	38.51	38.97	39.06	39.26	39.77	38.74	38.69	38.59	38.85	39.03
Animal No.	102	105	118	120	131	137	139	158	169			
Mean	38.72	39.03	38.90	38.76	39.16	39.10	39.01	38.90	39.10			

SMD at	5%	1%
Month (M)	0.21	0.28
Animal (A)	0.15	0.20

An insignificant correlation coefficient of 0.127 was noted between the body temperature of the native does and atmospheric temperature. Negative *r*'s were found between body temperature and humidity and rainfall.

Effect of season. Only the pulse rate was affected by season. It was higher in the dry (93.22) than in the wet season (90.30). The respiratory rate of the animals was 21.51 during the dry season and 21.17 during the wet season. The mean body temperature for the dry season was 38.93°C; during the wet season it was 38.99°C.

Other observations. During the study five animals, No. 105, 118, 131, 139, and 158, became pregnant and kidded. Kidding did not have any apparent effect on the pulse and respiratory rates and body temperature of the does.

PRICES OF PHILIPPINE FARM PRODUCTS [1]

C. D. KEARL

WITH FOURTEEN TEXT FIGURES

In a commercial free society prices guide the economy. They channel labor, capital, and natural resources into the production of the kinds of goods that the people of the country want most. They guide the flow of goods and services. They ration the supply. They decide who will receive what amount of the various products.

There are about 15.5 million people living on farms in the Philippines. What they produce and how well they live depend on the prices they receive. Even a part of the 5.5 million people not living on farms receive their income directly from the handling of agricultural products. The things they buy and sell and when they do their business are determined by prices. The entire 21 million people of the country consume farm products. What they eat and what they buy depend on the prices they have to pay.

Prices are always changing and prices of some products change more than others. Farm prices particularly are subject to variation. They vary from season to season and from year to year. They have cyclic patterns and trends. They have as their principal characteristic instability. Some farm prices vary more than others and not all vary at the same time.

The seasonal patterns of farm prices usually correspond to the seasons of production and the nature of the products. The tendency to move upward or downward over longer periods depends on the conditions within and without the industry.

This article presents a graphic portrayal of the movement of prices of 15 Philippine products. For each product the monthly prices and trend were determined. The seasonal pattern is based on the six-year average price for each month corrected for trend.

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[1] General Contribution No. 875.

PALAY, ORDINARIO

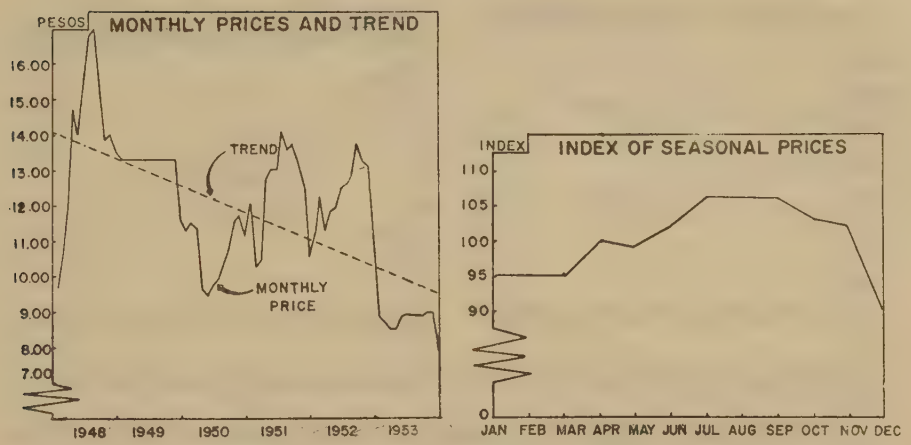

Fig. 1.—Left, monthly prices per sack; right, index of seasonal prices.

From 1948 to 1953 the price per sack (44 kilos) of palay decreased from ₱13.93 to ₱8.68. The decrease was not consistent, but prices in 1953 were low by all but prewar standards.

Palay seasonal prices are inverse to supply. The variation amounts to about 10 per cent. Most of this is due to storage costs.

RED CORN

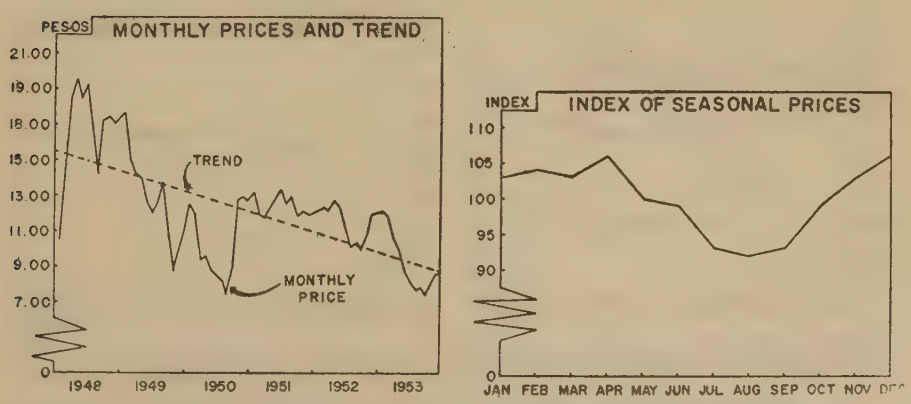

Fig. 2.—Left, monthly prices per sack; right, index of seasonal prices.

The price trend of red corn is similar to palay's. A sack of 56 kilos cost ₱16.67 in 1948 but could be bought for ₱9.04 in 1953. Corn prices tend to be less volatile than those of palay.

When palay is high in price seasonally, corn is low. The peak index of 106 in December is 14 points above the low of 92 in August.

BANANAS, LATUNDAN

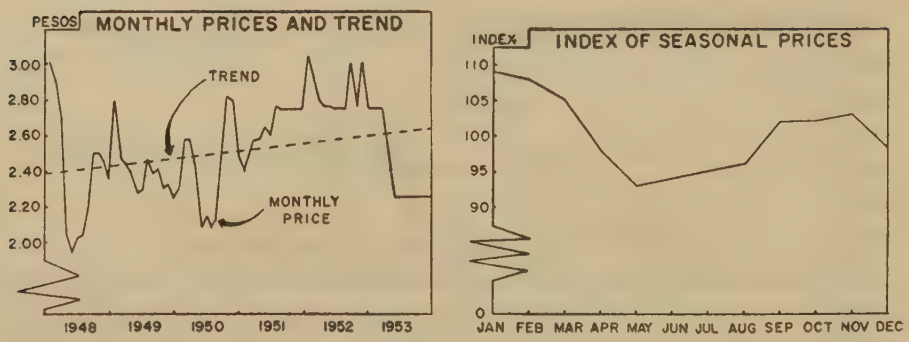

Fig. 3.—Left, monthly prices per 100; right, index of seasonal prices.

Bananas have increased in cost per hundred since 1948. This is a contrast to the falling prices of palay and corn.

Bananas are more plentiful in some seasons than in others and are not storable so that the price variations are relatively large. The variation amounts to 16 index points.

MUNGO, NATIVE YELLOW

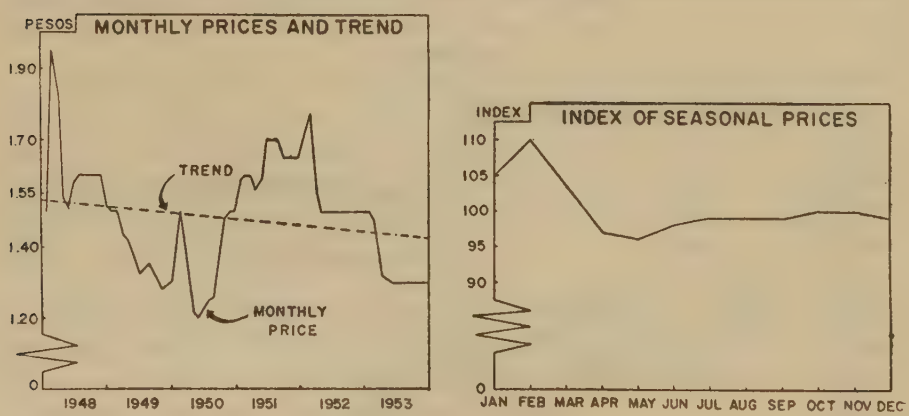

Fig. 4.—Left, monthly prices per ganta; right, index of seasonal prices.

The movement of mungo prices can best be characterized by a downward trend from 1948 to 1950, a sharply upward surge from mid-1950 into early 1952, and a downward "stepped" movement during 1952 and 1953.

Mungo prices have a peak in February but fall to a low, remarkably constant level from April to December. The variation amounts to 14 index points.

SUGAR, VICTORIAS

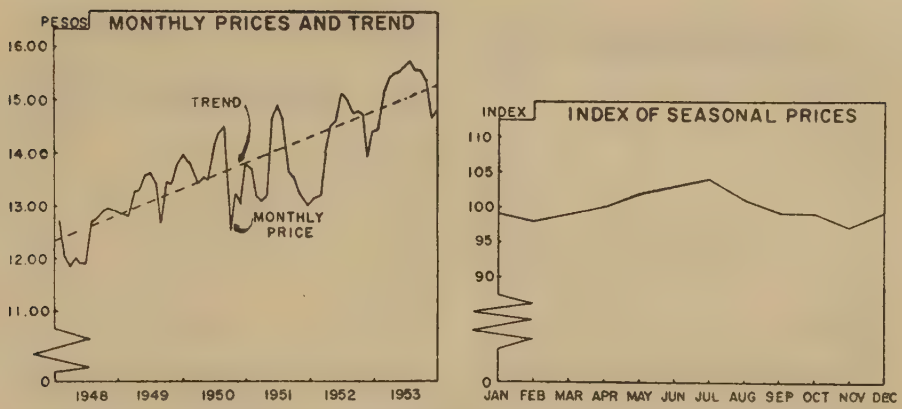

Fig. 5.—Left, monthly prices per picul; right, index of seasonal prices.

Sugar prices have been getting consistently better. The average price in 1948 was ₱12.47 per picul. In 1953 it was ₱15.29.

Seasonally sugar prices are highest in July and lowest in November. This does not coincide with the production pattern for the crop in this country, probably because of international trade.

COCONUTS, MEDIUM SIZE

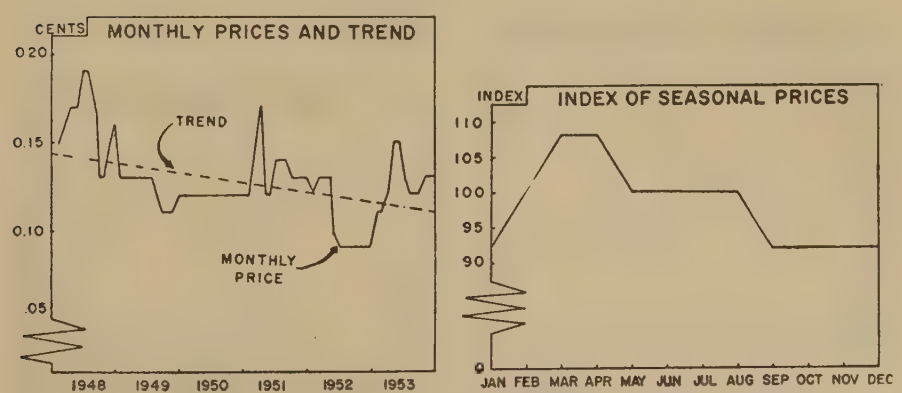

Fig. 6.—Left, monthly prices; right, index of seasonal prices.

The average price per coconut fell from 1948 to 1953. The prices for nuts have the characteristic of administered prices, i.e., they tend to step from one level to another.

The season of highest coconut prices is in March and April. This coincides to some extent with the production pattern. As yields increase the prices fall and remain low while nuts are plentiful.

COPRA, RESECADA

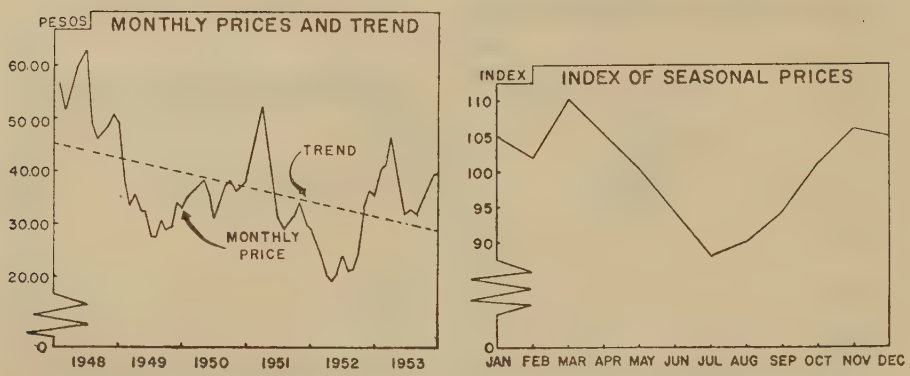

Fig. 7.—Left, monthly prices per 100 kilos; right, index of seasonal prices.

The fall in copra price was precipitous from mid-1948 to mid-1949. The recovery in 1949 and 1951 was followed by another decline and an abrupt increase.

The difference in copra prices is 22 index points where the annual average equals 100. The seasonal variability is probably influenced greatly by the supply of competitive products.

HEMP, DAVAO GRADE I

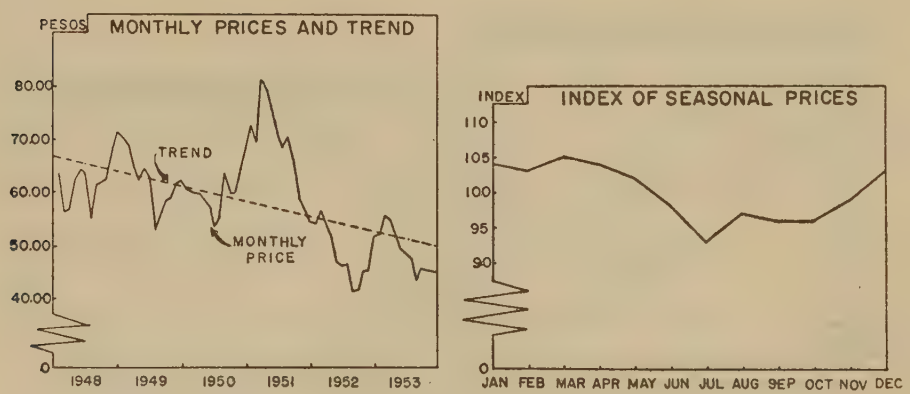

Fig. 8.—Left, monthly prices per picul; right, index of seasonal prices.

Hemp prices declined from 1948 to 1953. The trend was only broken by the increase from mid-1950 to mid-1954 due to the war scare. The average price fell from ₱62.06 in 1948 to ₱48.59 in 1953.

Hemp prices are high from December to May and low from July to October. Compared to most agricultural products, hemp has a small variation, averaging only 12 index points.

LEAF TOBACCO, ISABELA

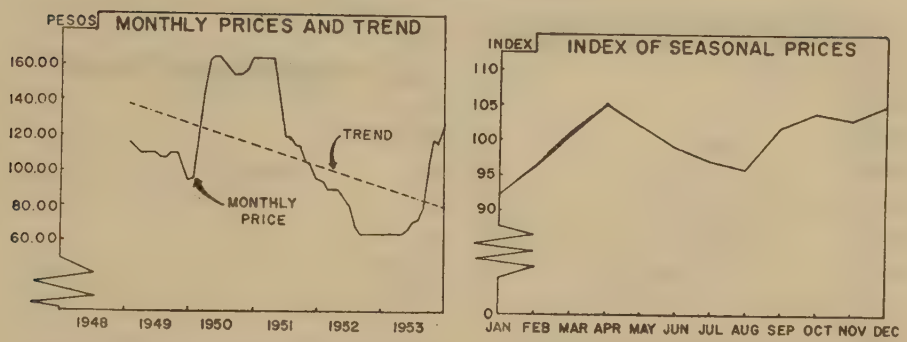

Fig. 9.—Left, monthly prices per bale; right, index of seasonal prices.

Tobacco prices are hard to predict. The tendency was for the price per bale of 115 kilos to decline from 1949 to 1953. However, there was no regularity in the pattern.

Seasonally the prices are high in April and again in December. The seasonal variation is moderate. It amounts to only a change of about 10 per cent.

PORK, PURE MEAT

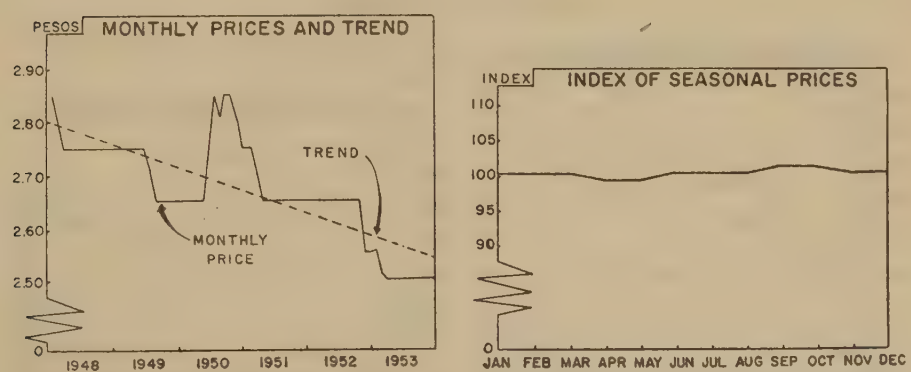

Fig. 10.—Left, monthly prices per kilo; right, index of seasonal prices.

Since 1948 pork prices have fallen at a rate of 4 per cent per year. With the exception of the "scare" prices of late 1950, the fall has been steadily downward. The low price of ₱2.50 per kilo in 1953 persisted for 10 months prior to the end of the year.

There is virtually no seasonal change in pork prices since hogs are butchered the year round.

FISH, FRESH BAÑGUS

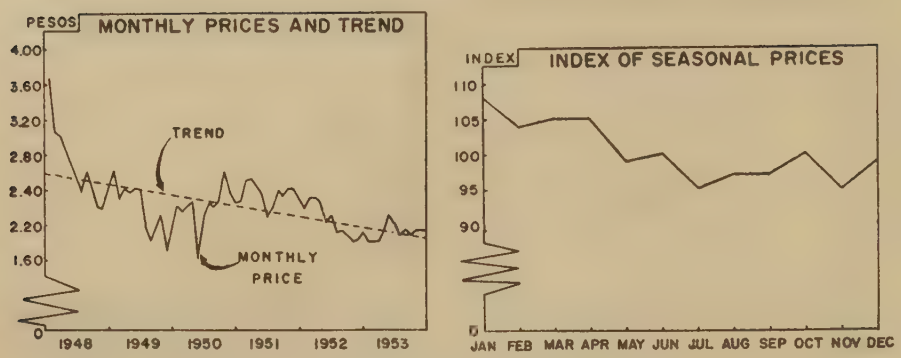

Fig. 11.—Left, monthly prices per kilo; right, index of seasonal prices.

Fish price trends are downward. Fresh bañgus, which cost ₱2.67 per kilo in 1948, was down to ₱1.91 in 1953. This is a decrease of 12 per cent per year.

Prices of fresh bañgus tend to be high in January and fall during the remainder of the year. The seasonal difference in fish prices amounts to 13 index points.

CHICKENS, "DUMALAGAS"

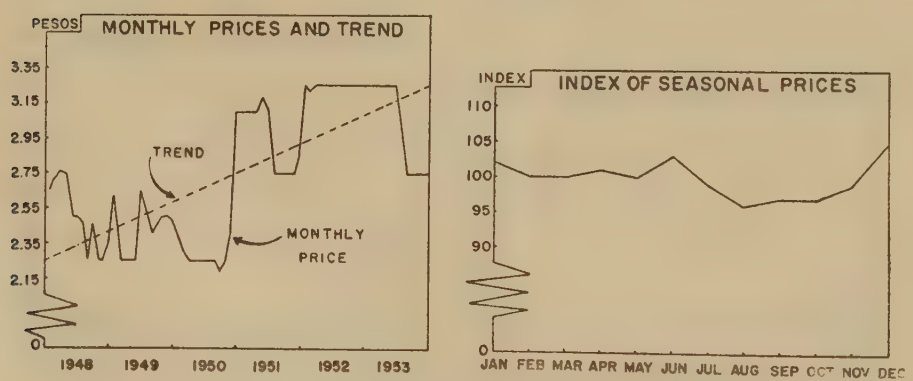

Fig. 12.—Left, monthly prices; right, index of seasonal prices.

Chicken prices in 1953 were 30 per cent higher than six years earlier. This was in spite of a sharp fall in prices during the last five months of 1953.

Prices are highest from December to June and lowest from July to November. These prices follow those of corn except that they lag by one month. The variability is only seven points.

HEN EGGS

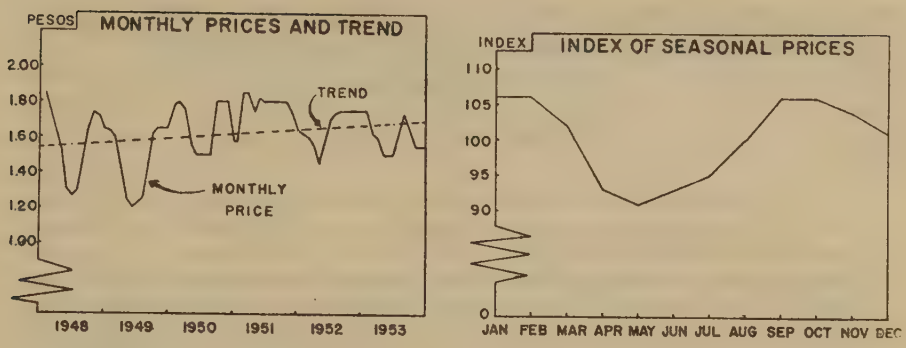

Fig. 13.—Left, monthly prices per dozen; right, index of seasonal prices.

The trend in hen egg prices from 1948 to 1953 was upward at a rate of 2.4 per cent per year. The movement around the trend line is consistently upward but shows a strong seasonal pattern.

Seasonally eggs are cheap from April through July and high from September through February. The seasonal variation amounts to 15 index points. The variation for this product is more pronounced than for most agricultural products.

DUCK EGGS

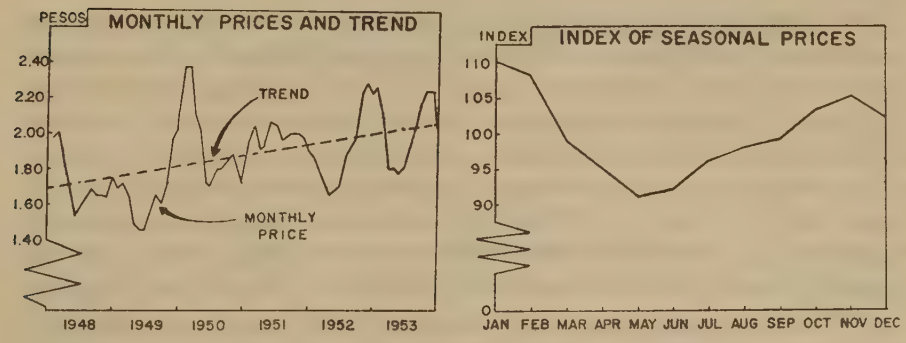

Fig. 14.—Left, monthly prices per dozen; right, index of seasonal prices.

Duck eggs, like hen eggs, increased in price per dozen during the years 1948 through 1953. The rate of increase was 6 per cent per year, which is slightly more than twice the rate of increase for hen eggs.

The seasonality of duck egg prices is evident from a cursory study of their movement around the trend line. Prices are low in May and high in January. The difference is 19 points.

QUALIFICATIONS OF AGRICULTURAL TEACHERS IN GENERAL, AGRICULTURAL, AND RURAL HIGH SCHOOLS [1]

VALENTIN G. CEDILLO

The majority of the teachers now teaching vocational agriculture in the public high schools are inadequately trained professionally. Most of them have temporary, emergency, or substitute appointments. In general, they do not stay long in the service. About 25 per cent of them have civil service eligibility for teaching vocational agriculture. The lowest paid teacher gets ₱115 a month, and the highest, ₱245. The majority of the teachers in the agricultural and rural high schools are graduates of the UP College of Agriculture at Los Baños, Laguna. Most of the secondary agricultural school graduates who are teaching are in the general high schools. The teachers in the agricultural and rural high schools are better qualified than those in the general secondary schools. Nearly 44 per cent of the teachers desire to enroll in agricultural education subjects.

After the Second World War, there was a lack of properly trained teachers of agriculture in the secondary schools of the Philippines. Teachers who did not possess the necessary educational and professional qualifications had to be employed. This has handicapped the present educational system greatly.

This study was undertaken to determine (1) the educational and professional qualifications of teachers of agriculture in the general, agricultural, and rural high schools; (2) the factors affecting their efficiency; (3) their deficiencies in teaching preparation; (4) their in-service training since entrance into the service; and (5) the means of improving the qualifications of prospective teachers and those already in the service. Some other factors such as the occupational background of vocational agricultural teachers, civil service eligibility, salary, and length of teaching experience were brought to light.

The work was started in November, 1951, and extended up to the school year 1952-53. Three types of high schools were incuded: general, which numbered 287, or 89 per cent; agricultural, 23, or 7.4 per cent; and rural, 10, or 4.2 per cent (table 1). Of the 310 high schools studied, only 260 responded to the questionnaires. The major part of the data on the high schools and teachers was obtained

[1] Central Experiment Station Contribution No. 1846.

from the General Office, Bureau of Public Schools, Manila. Information on such factors as location of schools, types of communities where teachers were brought up, farming experience, deficiencies in preparation felt by teachers in the service, and occupational background was obtained through questionnaires sent to the teachers and principals.

EDUCATIONAL AND PROFESSIONAL QUALIFICATIONS

The average years of preparation of teachers were as follows: general, 2.71 years; agricultural, 2.95; and rural, 3.74. The overall average was 2.84 years.

Of the 560 agricultural teachers, 8 held postgraduate degrees (M.S.A. and Certificate in Agricultural Education); 319, or 56.9 per cent, were college graduates; 47, or 8.4 per cent, college undergraduates; and 119, or 21.3 per cent, graduates of agricultural and rural high schools. The teachers who were trained in the colleges of education, liberal arts, and veterinary science, normal schools, and schools of arts and trade made up for their deficiencies in preparation for vocational agriculture mostly by acquiring farming experience, reading on farming practices, attending summer professional courses and school conferences.

Only 30 teachers, or 5.4 per cent, possessed adequate professional training for teaching vocational agricultural subjects. This training was largely undergone at the UP College of Agriculture, Los Baños, Laguna. About 25 per cent took in-service training or earned units of credit in the Department of Agricultural Education, UP College of Agriculture, or in summer classes at the Central Luzon Agricultural College, Muñoz, Nueva Ecija, and the National Regional Agricultural Schools of Baybay and Bukidnon. Other teachers attended Saturday classes sponsored by the Bureau of Public Schools. One teacher at Baybay had six months of training under Fulbright professors at the Bukidnon National Agricultural School. More than 46 per cent did not have professional training for teaching.

The Bureau of Public Schools, since the school year 1948-49, has required teachers of agriculture to have at least 18 units of education subjects. Holders of B.S.A. and B. Agr. degrees and Certificates in Agricultural Education who qualify in either the senior or the junior teacher examination (agriculture or academic) are eligible for regular appointment in general, secondary, agricultural, and rural high schools and in national schools of agriculture. Sec-

ondary agriculture graduates are eligible for appointment as farm managers in secondary and rural high schools. But on account of the shortage of qualified teachers, the general high schools are employing secondary agriculture graduates as emergency teachers of agriculture. The rapid increase in the number of general high schools offering required vocational courses is partly responsible for this condition.

EFFICIENCY RATING

A very highly subjective device for evaluating teachers in the service is the efficiency rating. This depends on a number of factors, such as health, command of English, mastery of subject matter, skill in teaching, evidence of cultural and professional growth, initiative and executive ability, loyalty and cooperation, industry, punctuality, regularity of attendance and reports, and standing with students and fellow teachers. Even if a teacher is educationally fit and has civil service eligibility, he cannot be promoted in rank or increased in salary if his efficiency rating is below average.

Of the 560 teachers studied, 87, or 15.5 per cent, received excellent rating; 128, or 22.9 per cent, average; and the majority, 345, or 61.6 per cent, above average.

TRAINING DEFICIENCIES

One of the concessions given by the Bureau of Public Schools to teachers who do not meet fully the requirements for regular appointment in the secondary schools but whose appointments have been made regular and have been duly attested to by the Commissioner of Civil Service is recognition of these appointments as they are, provided such teachers complete the educational requirements as soon as feasible. These teachers are permitted to pursue further studies during Saturdays and long vacations, under the minimum study load of teachers.

In this study, an attempt was made to determine the training deficiencies of teachers in the field. Of 467 teachers, 203, or 43.6 per cent, desired to take courses in agricultural education; 162, or 34.5 per cent, decided to take courses in general agriculture, chemistry, agronomy, horticulture, animal husbandry, soils, agricultural economics, mechanized farming, agricultural botany, economic entomology, plant pathology, administration and supervision of agricultural schools and home and school projects; and 102, or 21.9 per cent, were noncommittal.

IN-SERVICE TRAINING

The rapid rate of replacement among teachers of vocational agriculture should invite the special attention of vocational school officials to the improvement of teachers in service. The employment of teachers occupationally competent but without much professional training is a temporary expedient. The improvement of teachers in service must be carefully scrutinized from a long-term angle.

Various methods have been suggested for the improvement of teachers in service: (1) short, informal, extensive, noncredit courses given by local school officials without the help of teacher-trainers; (2) intensive courses, either credit or noncredit, given on campuses or through extension; and (3) functional, approved correspondence courses for those who cannot avail themselves of extension or resident instruction. One of the most effective means of helping a new teacher is to assist him in his work, with or without supplementary instruction, depending upon what help is available and possible.

There are various types of in-service training. They may be of the refresher or stimulation type. Others are really retraining programs for advancement within the school system or may be shifting programs to take advantage of new educational development. Through in-service training, regular classroom teachers may qualify themselves to become guidance counselors, workers in clinics, or members of supervisory, administrative, and many other specialized fields, such as the library, research, and curriculum making. A planned program for continued growth of teachers will utilize many mediums and varied types of experiences such as (1) visitation and exchange teaching; (2) use of consultant and supervisory techniques; (3) cooperative participation in provincial, regional, and national studies; (4) attendance at workshops; (5) acquiring of additional degrees; (6) study and utilization of newer procedures such as clinics and visual and auditory aids; (7) attendance at planned faculty meetings; (8) conducting of individual research about children, community, subject matter, or methods; and (9) participation in professional group activities.

ELIGIBILITY, BACKGROUND, SALARY, AND TEACHING EXPERIENCE

Of the 560 teachers, 102, or 18.2 per cent, qualified in the senior teacher examination (agriculture, trades and arts, or academic); 59, or 10.5 per cent, in the junior teacher examination (agriculture, arts and trades, or academic); 56, or 9.9 per cent, in examinations other

than those for teaching. A big proportion, 343, or 61.2 per cent, had no civil service eligibility of any kind. Only two teachers took advantage of Republic Act No. 186 which confers automatic civil service eligibility on a teacher with 10 years of continuous teaching experience.

Of the 467 teachers who sent in answers on their educational background, 357, or 76.5 per cent, had farmer parents. Other things being equal, a teacher who grows up on the farm is more likely to become a better teacher of agriculture.

Competent teachers must receive an income which can provide for a reasonable standard of living. They must be assured of satisfactory working conditions, including stability of tenure and opportunity for advancement. Of the 560 teachers, 415, or 74.0 per cent, got less than ₱150; only 3, or 0.6 per cent, got more than ₱200 a month. Republic Act No. 312 provides for a revised salary scale and automatic salary increases for public school officials, teachers, and other personnel of the government. This act fixes the entrance salary of secondary classroom teachers at ₱1800 per annum.

The length of teaching experience may be a good measure of the teacher's satisfaction with his job. There are a number of teachers who, because they have come to love teaching, have remained in the service despite a comparatively low salary. Their greatest satisfaction lies in seeing young boys and girls develop into productive citizens.

Of the 560 teachers, 348, or 62.2 per cent, had teaching experience of not more than 5 years, and only 1, or 0.2 per cent, had teaching experience of 38 years. The average teaching experience in each of the different types of high schools was as follows: general, 5.9 years; agricultural, 8.0; and rural, 6.9. Teachers in the agricultural and rural high schools generally stay longer in the service because of free quarters, a cheaper cost of living, and a more or less secure tenure.

SOME SOLUTIONS TO TEACHERS' PROBLEMS

Some of the suggested solutions to the problems of agricultural teachers are as follows:

1. Duly qualified teachers in the secondary schools should be given a higher entrance salary of at least ₱200 a month, with automatic increases after five years of successful teaching until the maximum is reached.

2. The yearly civil service examination for teachers of agriculture should be given before June 15 and the results released promptly before April 30 of the following year so that proper adjustments in salary or term of appointment may be made before the opening of classes.

3. Inasmuch as the majority of the teachers have no civil service eligibility, the licensing of prospective teachers, which works in the same way as the licensing of lawyers, doctors, etc., should be instituted.

4. Deserving teachers should be allowed to pursue graduate studies on scholarships, visit other outstanding teachers, observe at conferences or workshops, attend summer vacation classes with credit or on liberal terms, and awarded prizes, medals, diplomas, or certificates in recognition of long years of fruitful service to education.

TABLE 1.—*Number of schools and teachers studied*

	LUZON			VISAYAS			MINDANAO		
	Type of High School								
	General	Agricultural	Rural	General	Agricultural	Rural	General	Agricultural	Rural
Number of schools studied	118	8	7	114	8	3	45	7	—
Number of teachers:									
Male	185	47	42	142	34	15	51	37	0
Female	6	0	0	1	0	0	0	0	0

TABLE 2.—*Summary table* [a]

ITEM	REGION			TYPE OF HIGH SCHOOL		
	Luzon	Visayas	Mindanao	General	Agricultural	Rural
Age of teacher, years	37.1	38.4	37.5	37.4	38.3	36.9
Where teaching:						
In home province	69.6	71.3	21.5	70.9	28.8	77.2
Outside home province	30.4	28.7	78.5	29.1	71.2	22.8
Farming experience	7.7	8.8	6.9	7.9	8.4	8.5
Educational attainment:						
B.S.A. (UP, AIA, U.S.A.)	60.0	23.4	43.2	38.9	55.9	61.4
High school	10.0	37.0	22.7	23.9	19.5	7.0
Professional training:						
Agric. educ. (Phil.)	5.7	3.1	7.9	3.9	9.3	5.3
General education	10.0	7.8	13.6	13.5	0.85	0.35
No professional training	47.1	52.6	34.1	44.4	51.7	54.4
Institution where trained:						
U.S.A.	3.6	1.04	0	1.8	2.5	3.5
UP College of Agriculture	74.6	45.3	45.4	55.3	69.5	71.9
CLAC	8.6	20.8	23.9	18.2	11.0	3.5
Nat. Regional Agric. School	2.4	17.7	1.1	7.3	8.5	5.3
Civil service eligibility:						
Senior teacher in agriculture	20.3	8.3	10.2	9.9	17.8	22.8
Junior teacher in agriculture	5.7	9.9	4.5	6.5	9.3	5.3
Junior teacher regular	2.1	40.1	2.3	3.4	0.8	1.8
Prov. agric. supervisor	2.5	1.0	5.7	3.4	0.8	0
Mun. agric. inspector	2.9	4.2	5.7	3.9	1.7	7.0
Without eligibility	58.2	59.9	62.5	64.7	52.5	56.1
Teaching experience, years	6.4	5.7	5.5	5.9	8.0	6.8
Terms of appointment:						
Regular	30.4	16.1	13.6	18.7	28.8	38.6
Temporary	45.7	34.4	54.5	40.5	50.8	45.6
Emergency	21.8	49.5	31.8	39.5	19.5	15.8
Salary a month, pesos	154.05	148.75	151.19	148.65	153.75	147.47
Assignment according to:						
Major	37.1	18.2	36.4	28.8	40.7	21.1
Minor	16.1	6.3	12.5	10.1	18.6	12.3
Major-minor	16.7	10.4	12.5	11.4	18.6	21.1
Not related	49.6	22.0	45.6	49.6	22.0	45.6
No. of preparations	3.0	2.9	2.7	3.1	2.2	2.9
Efficiency rating:						
Excellent	18.2	14.1	10.2	12.7	16.9	31.6
Above average	61.4	59.9	65.9	61.3	62.7	61.4
Average	20.4	26.0	23.9	26.0	20.3	7.0
Course desired to be taken:						
Agricultural education	51.6	35.0	37.6	38.9	57.4	44.4
Agronomy	5.3	10.2	1.1	8.1	5.9	11.1
Poultry and swine	5.8	10.1	5.9	6.5	7.9	11.1
Noncommittal	23.6	16.6	27.1	26.5	7.9	20.0

[a] All figures are in per cent, except where indicated.

COLLEGE AND ALUMNI NOTES

A department undersecretary and a general were the two convocation speakers of the College in August.

Undersecretary Jaime N. Ferrer of the Department of Agriculture and Natural Resources explained the administration's rural program at the convocation sponsored by the Beta Sigma Fraternity on August 25.

Similarly, Brigadier General Alfredo M. Santos, commanding officer of the Second Military Area, spoke on rural development at the Rural High School celebration of National Heroes Day on August 29.

Earlier, on July 29, the Rural High students were enjoined to plant a forest by Dr. Chester Hunt, FAO (UN) technical advisor to the Forest Products Laboratory. The Arbor Day speaker declared that planting one tree on the school grounds and then forgetting about it was not the proper way to learn about growing forest trees. One tree does not make a forest, he said, it is only a symbol. "Plant a forest."

The College now counts the following among its researchers and instructors:

Department of Agricultural Chemistry—Juanita M. Castillo, assistant instructor;

Department of Agricultural Engineering—Ernesto V. Bacalzo, Alfredo B. de Guzman, Nardo J. Santos, Rodolfo C. Yaptengco, assistant instructors;

Department of Agronomy—Sotero I. Albano, Jr., research instructor; Protacio V. Quiamco, assistant instructor; David D. Gorrez and Santiago H. Dacanay, research assistants;

Department of Animal Husbandry—Alvaro N. Balcita, graduate research fellow;

Department of Home Technology—Betsy Ruth Cabatit, assistant instructor;

Department of Plant Pathology—Florendo C. Quebral, assistant instructor; Ofelio R. Exconde, graduate fellow;

Department of Soils—Jesus B. Caingcoy, research assistant.

Class '55 is certainly going places. Isabel Malabanan Twitchell now works at Eastman Kodak Co. in far away Rochester City, New York. Nearer home Leonardo C. Cosico, Gil T. Manza, Enrique A. Sindico, and Angel V. Sobrepeña have all landed berths in the Philippine Sugar Institute. Severino Memita, on the other hand, is with the Agricultural Tenancy Commission. Ramon C. Alcachupas prefers the Division of Agricultural Economics, DANR.

Agricultural botanists took over the 234th meeting of the Los Baños Biological Club on July 29. Gregorio C. Lugod read a paper on "Experimental studies for the control of Sapinit (*Lantana camara* L.) with different herbicides." Dr. S. N. Fertig and M. R. Vega collaborated on the "Inhibition effect of maleic hydrazide (H-40) on the growth of lawn grasses."

Not to be outdone, the Lino Nazarenos have come up with 10-lb. Raul Ignacio. Welcome relief after the heavy crop of baby boys is Patricia, born to the Apolinario Carañgals on July 29.

Dr. Lyle E. Nelson is the new soils man under the Cornell-Los Baños contract vice Dr. M. G. Cline, now Project Leader. Dr. Nelson is a product of the North Dakota Agricultural College and Cornell University. He comes to Los Baños from his agronomy and soils classes at the Mississippi State College.

Three one-act plays made up the semestral offering of the Speech and Dramatics Club currently advised by Iluminada Magno and Edgardo de la Cruz. "A Love Passage" by W. W. Jacobs, "The Goal" by Henry Arthur Jones, and "Altruism" by Karl Ettlinger were presented on the night of July 29 at the Rural High School Auditorium.

First of last year's PHILCUSA-FOA trainees to get back into harness is Ibarra S. Santos of the Plant Breeding Division. He brings with him a brilliant academic record from Nebraska University.

Twenty-three of this year's PHILCUSA-FOA grants went to alumni in the Department of Agriculture and Natural Resources: Pablo B. Agcanas, '37; Proceso E. Alcala, '33; Fernando B. Bernardo, '32; Salvador F. Bolivar, '28; Daniel P. Caguioa, '52; Guillermo L. Canlas, '33; Eliseo C. Carandang, '33; Nicomedes C. Flores, '27; Elpidio F. Galado, '43; Artemio E. Gesmundo, '30; Teodoro T. Gonzalez, '34; Evaristo A. Hurtado, '33;

Epitacio A. Lanuza, '30; Pascual M. Matulac, '30; Honesto R. Mercado, '42; Manuel R. Monsalud, '31; Santiago M. Rolle, '41; Jaime

T. Santiago, '51; Narciso S. Sibal, '34; Pio A. Tadena, '38; Martin V. Tiangco, '36; Albino P. Varona, '29; and Telesforo A. Vea, '42.

Back from their PHILCUSA-FOA travels are Prof. Alejandro B. Catambay and Felipe T. Aala, '34. The head of the Department of Agricultural Engineering visited experiment stations abroad for three months. Felipe T. Aala, superintendent of the La Granja Experiment Station at La Carlota, Negros Occidental, studied corn breeding for a year at the University of Illinois.

US Ambassador to the Philippines and Mrs. Homer Ferguson paid the College an informal visit on July 25. They took pictures of the Soils experiment on corn, the Murrah cattle in the pasture, the corn and rice plots, the rust-free coffee, the sand culture work of Botany on abaca and coffee, and the student center.

Serapion J. Bayubay, '42, associate agronomist and superintendent of the tobacco breeding project at the Los Baños Economic Garden arrived on July 28 after a two-month stint as FOA technical tobacco consultant to the Indonesian government.

The B. M. Gonzalez Memorial Fund mounted to ₱20,245.55 with contributions from the Pasudeco Planters' Association, alumni at the Bureau of Plant Industry, and the Cagayan-Isabela Varsitarians.

Leandro Sinco, '50, left for a tour of "schools that run industries that substantially help the institution." What "know-how" that he picks up will presumably be for the Foundation College in Dumaguete City.

Nathaniel B. Tablante, '46, took time out from his doctorate studies at Purdue University to attend the International Conference of Agricultural Economists at Helsinki, Finland, from August 19 to 26. The trip was made possible by a $900 fellowship grant from the Council on Economic and Cultural Organization of the United Nations.

The Albatros Company of Holland presented the College with ₱2000 with which to study soil fertility in the Philippines. At least four major agricultural soil areas will be tested for one year.

Frozen bull semen for the artificial insemination of 50 cows arrived by plane from Cornell University on August 23. The shipment will be used in the Animal Husbandry research plan to breed cows in the College and its environs. If successful locally the system will cut down the importation of expensive bulls and will allow the breeding of Philippine cows by bulls not for sale at any price.